

LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA20 | Curdworth to Middleton

Survey reports (CH-004-020)

Cultural heritage

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Department
for Transport

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Appendix CH-004-020

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1 Introduction

1.1 Structure of the cultural heritage appendices

1.1.1 The cultural heritage appendices for the Curdworth to Middleton CFA (CFA20) comprise:

- Appendix CH-001-020 – Baseline report;
- Appendix CH-002-020 – Gazetteer of heritage assets;
- Appendix CH-003-020 – Impact assessment table; and
- Appendix CH-004-020 – Survey reports (this appendix).

1.1.2 Maps referred to throughout the cultural heritage appendices are contained in the Volume 5 cultural heritage map book.

1.2 Surveys undertaken

1.1.3 This appendix contains the results of extensive archaeological surveys undertaken. Key surveys reported in this appendix include:

- LiDAR survey of the majority of the construction area;
- hyperspectral survey of the majority of the construction area;
- sketch survey of one site (CNo31), comprising a series of linked ponds located within woodland, probably associated with a nearby medieval moated site; and
- geophysical surveys at 2 locations along the route (CNo27 and CNo29) encompassing 5.7 and 18 hectares respectively.

1.1.4 The results of aerial photographic analysis have been incorporated into the baseline report in Appendix CH-001-20 and are not reported separately for this CFA.

2 LiDAR and hyperspectral survey report

2.1 Introduction

2.1.1 The Curdworth to Middleton CFA extends from Curdworth in the South to Middleton in the North, and comprises largely rural landscape, stretching for some 8.5 km on a broadly north to south alignment.

2.2 Methodology and limitations of analysis

LiDAR data

- 2.2.1 The filtered LiDAR data was used to create a Digital Terrain Model (DTM), and analysed in the GIS as three rasters comprising elevation data, a hillshade map and a slope map. Similarly, the unfiltered LiDAR data was used to create a Digital Surface Model (DSM) also analysed as elevation data, a hillshade map and a slope map.
- 2.2.2 Both the DTM and DSM were viewed as rasters in an ArcView GIS project. All identified features were digitised in the GIS from these rasters.

Hyperspectral data

- 2.2.3 The hyperspectral data was supplied as a series of ENVI DAT raster files, divided into 22 different sections (runs) covering the area of interest (CFAs 16 – 22). Each ENVI DAT contained 34 bands, representing a portion of the electromagnetic spectrum which included visible light and the near-infrared range. The data had a horizontal cell resolution of 1m.
- 2.2.4 A number of ArcGIS 10's out-of-the-box tools were used to extract, process and analyse the data. Initially, the ENVI DAT files were imported into a mosaic dataset stored within an ArcGIS 10 file geodatabase. A single combined raster dataset, containing the 34 bands, was created from the mosaic dataset.
- 2.2.5 As no more than three bands can be viewed at once using ArcMap (the red, green and blue bands of the raster dataset) there is a requirement to investigate subsets of the hyperspectral dataset. Particular attention was paid to the near-infrared and the visible red parts of the electromagnetic spectrum, due to the recognised potential of these in helping to highlight archaeological features (Parcak 2009, 101-2). The near-infrared range (760nm to 900nm on the electromagnetic spectrum) covered bands 6 to 13 in the hyperspectral dataset. The visible red range (605nm to 690nm on the electromagnetic spectrum) covered bands 18 to 22 in the hyperspectral dataset.
- 2.2.6 The near-infrared and visible red bands were extracted from the combined raster dataset, allowing for these bands to be viewed in isolation. Principal Component Analysis was also carried out on these bands using ArcGIS 10's Principal Components tool. The extracted bands were used to generate a series of single output raster datasets for both the near near-infrared and visible red hyperspectral data; this included a single principal component layer dataset and a multiple principal component layer dataset for both ranges. Different principal component layers could then be assigned to the red, green and blue bands of the multiple principal component layers raster datasets.

Digitising

2.2.7 All feature identification was undertaken manually and compared to the results of available aerial photograph evidence. Both hyperspectral and LiDAR plots were examined in detail and features and areas of likely archaeological potential were digitised manually using ArcGIS 10. These features can be seen in Table 1 below. Archaeological features have been assigned a unique WA number, and are briefly described. Where possible broad dates have been suggested based on the form of the features, and the identification of the features has been assigned a confidence rating (based on a simple five point scale (Low, Low to Moderate, Moderate, Moderate to High and High). Where possible, similar features with a common distribution (e.g. former field boundaries or ponds within a coherent area) have been grouped together.

Limitations

- 2.2.8 The LiDAR data used in the study of this CFA covered extended across both the land required, temporarily and permanently, to construct the Proposed Scheme and the wider 500m study area with the exception of a small area of land at Lea Marston. As a result, sites have been identified across both the land required, temporarily and permanently, to construct the Proposed Scheme and the wider study area.
- 2.2.9 Much of this stretch of the route is rural, and given over to farmland. Unfortunately, one result of this is that the DSM was less useful than expected as an interpretative tool, as the LiDAR seems to have been flown whilst the crops were fairly well developed. The main result of this is that these crops mask the underlying terrain on the DSM, reducing its effectiveness as an interpretative tool.
- 2.2.10 The DTM provides a model of the underlying terrain, stripping away crops and trees. As such it was particularly useful in allowing analysis of areas under trees or woodland. However, even on the DTM, in some areas, low lying ground crops or piles or other obstructions have limited the effectiveness of the LiDAR, with the result that, in a few cases, the ground modelling is far from clear.
- 2.2.11 Unfortunately, the Hyperspectral data provided did not contain bands representing the mid-infrared range (approximately 8500nm to 13000nm on the electromagnetic spectrum). The mid-infrared range is regarded as holding particularly high potential when attempting to identify archaeological features; the Hyperspectral dataset contained no data beyond 992nm on the electromagnetic spectrum.
- 2.2.12 The horizontal cell resolution of the data also restricted the identification of smaller features (1m intervals) is also likely to have influenced the visibility of small archaeological features and lessened the clarity of some of the larger features.
- 2.2.13 The effectiveness of Hyperspectral data in identifying archaeology can be significantly influenced by a number of factors, including the nature of the underlying geology, the water content of the ground and the type of ground cover. Significant areas of the route studied lie within dense woodland, where there is no likelihood of features being recognised through analysis of Hyperspectral data, or beneath cereal crops, where the identification of features is likely to vary. It also suffers from the same limitations as the LiDAR data in built up areas. Because of these variations, other techniques used for identifying areas of archaeological potential (notably the Normalised Vegetation Data Index (NVDI) and the Water Band Index) were not examined in detail.

2.2.14 The Hyperspectral data supplied covered the land required, temporarily and permanently, to construct the Proposed Scheme and also covered the majority of the 500m study area. The overall coverage provided by the Hyperspectral data is therefore excellent, although because of the number of variables affecting the visibility of features and the limitations in the bandwidth recovered, it should be noted that the features already identified are likely to represent only a portion of those within the CFA.

2.2.15 Despite these limitations, it is considered that the available LiDAR and Hyperspectral data provides comprehensive coverage of the land required, temporarily and permanently, to construct the Proposed Scheme as well as providing evidence for much of the surrounding 500m study area.

2.3 Results

2.3.1 A total of fifty seven sites were identified on the LiDAR plots within Community Forum Area 20. The bulk of these were identified on the LiDAR plots, with a smaller number also visible on the Hyperspectral imagery. Many appear on both. These are listed in Table 1 below

2.3.2 In keeping with the rural nature of this stretch of the route, the majority of the archaeological sites identified comprise the remains of field boundaries, ponds, hollows (likely to either be infilled ponds or quarries) and occasional survivals of the characteristic earthworks created by 'ridge and furrow' agriculture. The latter developed through the ploughing regimes of the medieval and early post medieval periods, and can provide key evidence of the location and extent of medieval open field systems. Interestingly, some ridge and furrow fields were recorded in woodland at Birch Wood (WA20.2), whilst a substantial moated site was also recorded in woodland (WA20.33 see Figure 1). From these it is clear that some elements of the medieval or post-medieval rural landscape were later allowed to return to woodland, or indeed may have been planted.

2.3.3 Combined with the evidence creation of larger fields through the removal of many of the earlier boundaries, this can tell us much about the development of the landscape through the medieval and post-medieval periods. Particularly well preserved examples of ridge and furrow were noted in the vicinity of the moated site to the south east of Middleton House Farm (WA20.31) and on Bodymoor Heath (WA20.34). A second, smaller and less well preserved moated site lies at Curdworth Hall Farm (WA 20.6)

2.3.4 A number of other significant sites were also recorded, including a number of probable millponds or fishponds. A series of ponds at Cuttle Mill (WA20.24) were clearly originally mill ponds, but now appear to be used as fish ponds. Two further ponds a short distance to the south east (WA20.23) may be related (see Figure 2).

2.3.5 Other sites of interest include a series of former leats and ponds in Sych Wood (WA20.8) which may represent the remains of a fishery or perhaps a former mill. A second group of similar ponds linked by ditches within woodland to the south of Middleton House Farm (WA20.29). these may also be fishponds, perhaps linked to the moated site a short distance to the north (WA20.33).

2.3.6 Towards the northern end of this stretch of the route, Middleton Hall (WA20.43) lies at the centre of formal gardens and landscaped grounds including areas of parkland (see Fig 1.3). The route is also crossed by the line of the Birmingham and Fazeley Canal (WA20.28) a reminder of the industrialisation of the area in the post-medieval and modern periods. Two short stretches

of meandering earthworks probably mark a former channel of a former stream or watercourse (WA20.50).

2.4 Summary

2.4.1 This stretch of the route is largely rural, and the sites are dominated by former field systems, relict boundary ditches, ponds and hollows. Ridge and furrow is evident, suggesting medieval agriculture. A substantial moated site, a second moated site, the site of a former mill and several probable fishponds may also be medieval in date. Post medieval and modern sites include Middleton Hall and its associated gardens and parkland and the line of the Birmingham and Fazeley Canal. An undated former watercourse may also have been the focus of earlier human activity.

2.5 References

Parcak, S, H. (2009), *Satellite Remote Sensing for Archaeology*. Routledge, Abingdon.

2.6 Figures

Figure 1: Sites WA 20.29, 20.31 and 20.33. Moated site (pink) ridge and furrow (orange) and former ponds (blue) SE of Middleton House Farm on LiDAR plots

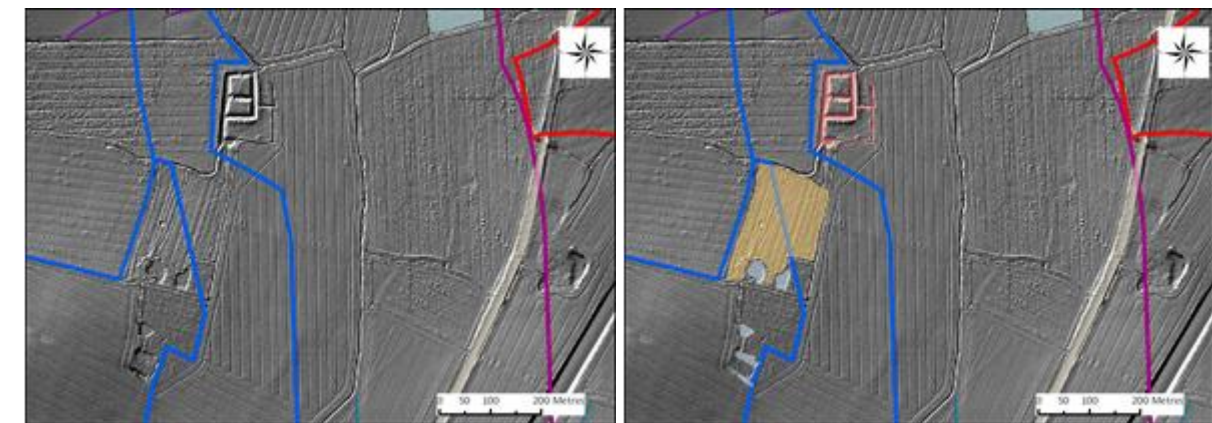
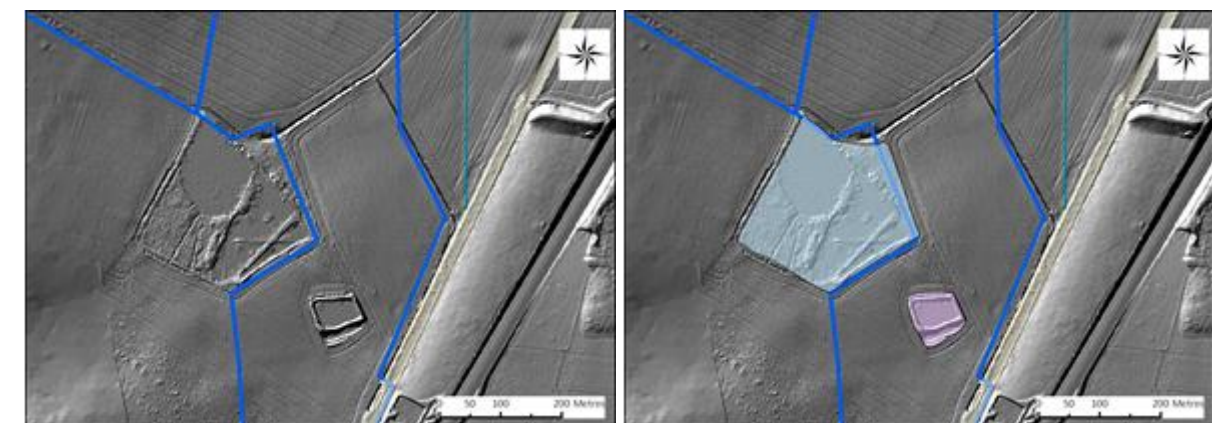
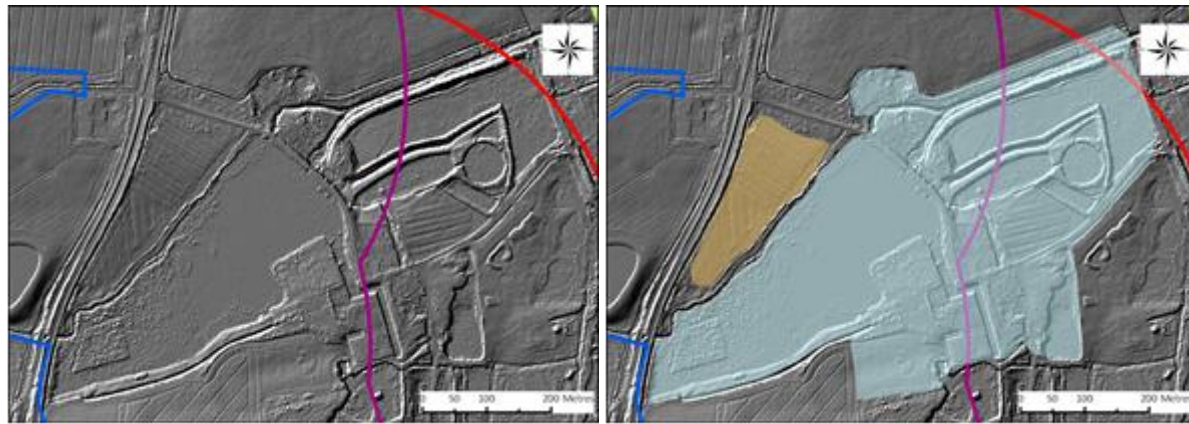


Figure 2: Sites WA 20.23 and 20.24. Ponds at Cuttle Mill ((blue) and to the south east of Cuttle Mill (purple) on LiDAR plots



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Figure 3: Sites WA 20.43 and 20.46. Landscaped grounds of Middleton Hall (blue) and area of former ridge and furrow (orange) on LiDAR plots



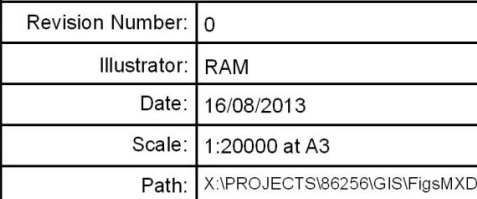
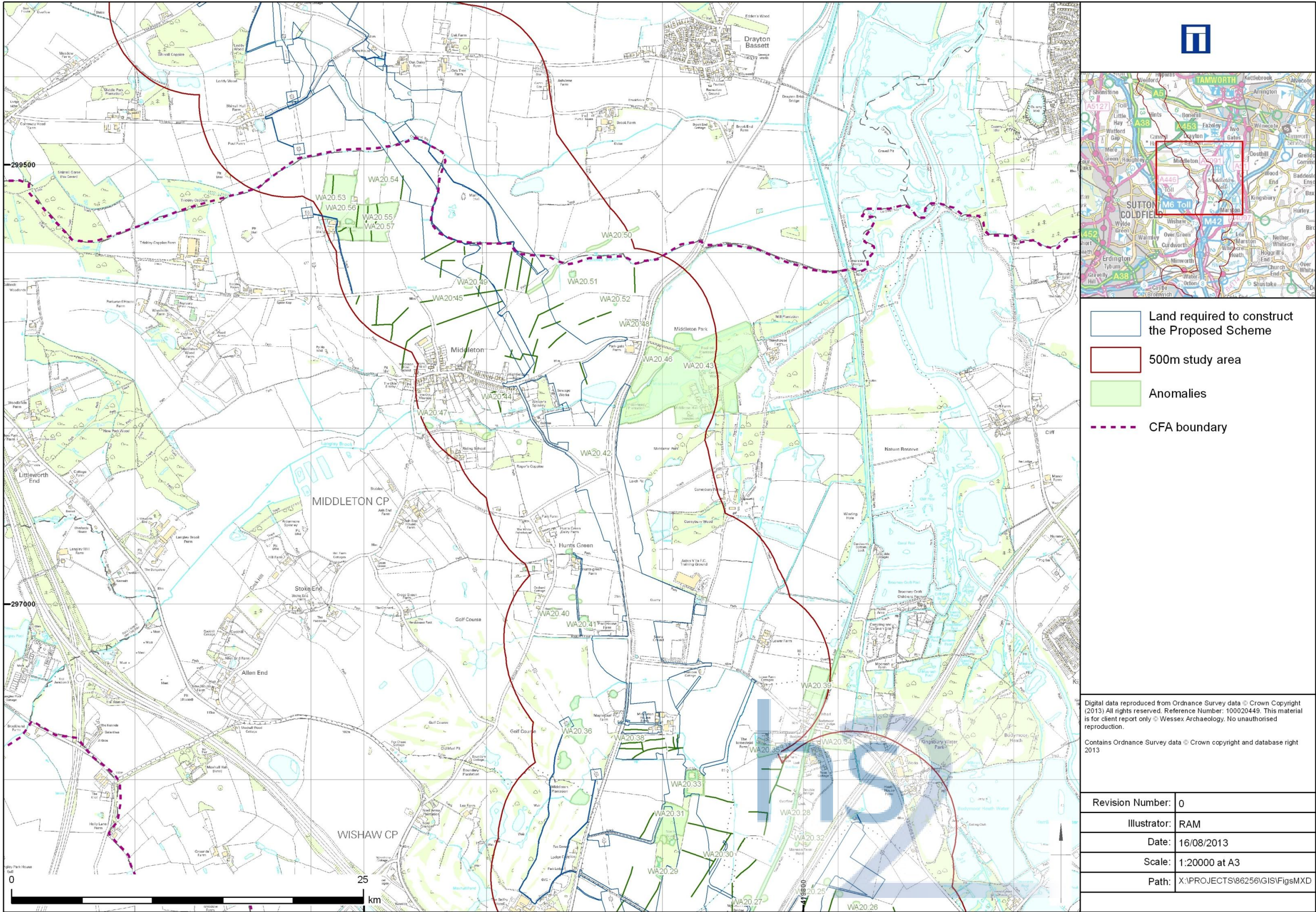


Figure 5: Anomalies within CFAzo



2.7 Identified sites

Table 1: Sites within CFA21

No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA20.1	CWM113	North east of Birch Wood	418185	292910	Irregular hollow. Possibly a former quarry. Visible on LiDAR plots	Undated	Moderate to High
WA20.2	CWM002	Birch Wood	419640	292470	Areas of ridge and furrow ploughing preserved within the wood on a WNW-ESE alignment Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.3	Modern feature – not included in CH-002-020	W of Newlands Farm	419035	292210	Two linear boundaries, probably the remains of former field boundaries. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.4	CWM007	Farthing Lane, Curdworth	418185	292910	Irregular Pond. Possibly a former quarry. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.5	CWM005	Butlers Croft, Curdworth	418210	292400	Area of possible ridge and furrow on a N-S alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.6	CWM007	Curdworth Hall Farm	418270	292850	Moated site associated with former field boundaries and small area of possible ridge and furrow on a W-E alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.7	CWM008	Sych Wood and surrounds	419860	292810	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.8	CWM008 and CWM009	Sych Wood, S of Woodhouse Farm	420115	292900	Series of water management features, 2 ponds and other earthworks in Sych Wood. The ponds may and leats belong to a mill or fishery. Visible on LiDAR plots	Medieval/post-medieval/modern	Moderate to High
WA20.9	CWM009	W of Woodhouse Farm	420100	293165	Two linear boundaries, probably the remains of former field boundaries. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.10	Modern feature – not included in CH-002-020	W of Woodhouse Farm	419620	293165	Irregular Pond. Possibly a former quarry. Visible on Hyperspectral and LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.11	CWM010	S of Blackgreaves Farm	419735	293460	Two sub oval hollows, probably a former quarries/ponds. Visible on LiDAR plots	Undated	Moderate to High

No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA20.12	Modern feature – not included in CH-002-020	S of Blackgreaves Farm	419690	293350	Oval pond. Possibly a former quarry. Visible on both Hyperspectral and LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.13	Modern feature – not included in CH-002-020	Golf Club, Lea Marston	419475	294045	Sub oval hollow, probably a former quarry/pond. Visible on LiDAR plots	Undated	Moderate to High
WA20.14	Modern feature – not included in CH-002-020	N of Dunton Hall	419020	293570	Oval pond. Possibly a former quarry. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.15	Modern feature – not included in CH-002-020	NE of Dunton Hall and S of Blackgreaves Farm	420045	295210	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.16	CWM016	Playing field S of Golf Club, Lea Marston	419900	294085	Possible ridge and furrow aligned ENE to WSW. Visible on LiDAR plots	Medieval/post-medieval	Moderate
WA20.17	Modern feature – not included in CH-002-020	Golf Club, Lea Marston	419660	294045	Series of ponds on golf course. Presumably modern in origin. Visible on LiDAR plots	Modern	Moderate to High
WA20.18	Modern feature – not included in CH-002-020	Mullensgrove Farm	419350	293950	2 ponds, the one to the north east is clearly ornamental, being sub-rectangular with a central spine. Visible on both Hyperspectral and LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.19	Modern feature – not included in CH-002-020	N of Cocksparrow House Farm	419720	295050	Pond. Roughly oval in shape. Possibly a former quarry. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High
WA20.20	CWM020	Cocksparrow House Farm	419720	295050	Area of possible ridge and furrow on a NNE-SSW alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.21	Modern feature – not included in CH-002-020	West of Marston Fields Farm	420000	294700	Area of linear earthworks aligned W-E. These do not appear to represent ridge and furrow. Modern in origin?. Visible on LiDAR plots	Modern?	Low to moderate
WA20.22	CWM019	SW of Parklands Stud	419505	294435	4 linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/Modern	Moderate to High

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No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA20.23	Modern feature – not included in CH-002-020	SE of Cuttle Mill	419180	294880	Two ponds and associated earthworks to the south east of Cuttle Mill. Mill ponds/fish ponds?. Visible on both Hyperspectral and LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.24	CWM021	Cuttle Mill	419020	295070	Series of ponds initially used as mill ponds. Now used as fishery. Visible on both Hyperspectral and LiDAR plots	Medieval/post-medieval/modern	High
WA20.25	Modern feature – not included in CH-002-020	NE of Cocksparrow House Farm	420045	295210	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA20.26	Modern feature – not included in CH-002-020	NE of Cocksparrow House Farm	420150	295250	4 roughly oval hollows. Probably the remains of quarries or ponds. Visible on LiDAR plots	Undated	Moderate to High
WA20.27	Modern feature – not included in CH-002-020	North West of Cocksparrow House Farm	419535	295310	2 roughly oval hollows. Probably the remains of quarries or ponds. Visible on LiDAR plots	Undated	Moderate to High
WA20.28	CWM070	Birmingham and Fazeley Canal	419300	294830	Post-medieval or modern canal. Visible on both Hyperspectral and LiDAR plots	Post-medieval/modern	High
WA20.29	CWM023	S of Middleton House Farm	419000	295550	Five ponds all linked to each other and the moated complex by manmade ditches. The southernmost three all lie together. Possible fishponds? Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.30	CWM026	SE of Middleton House Farm	419350	295700	Field boundaries. Series of low earthworks apparently belonging to an earlier field system, on a slightly different alignment to the modern one	Medieval/post-medieval	Moderate to High
WA20.31	CWM025	S of Middleton House Farm	419060	295750	Probable area of former ridge and furrow to the south of moated complex on a NNE-SSW alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.32	CWM129	SE of Marston Farm Hotel	419820	295655	3 ponds to the SE of the hotel. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High

No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA20.33	CWM027	Moated site SSE of Middleton House Farm	419190	295973	Moated site, probably medieval in date. Two rectangular platforms, each with a causeway to the north in the north western corner of the complex for the focus. These are defined by a wide moat. An L shaped platform to the south and south east and a sub-rectangular platform to the east are defined by a smaller moat. both moats are linked to water filled ditches to the south. Visible on LiDAR plots	Medieval/post-medieval	High
WA20.34	CWM031	Bodymoor Heath	420000	296220	Area of former ridge and furrow on a WNW-ESE alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.35	CWM028	S of Homestead Farm	419590	296165	Area of former ridge and furrow on a ENE-WSW alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.36	Modern feature – not included in CH-002-020	The Belfry Golf Course and Maple Leaf Farm	418520	296250	Five ornamental ponds. Four large ponds on the golf course and a circular pond to the north west of Maple Leaf Farm. Visible on Hyperspectral and LiDAR plots	Modern.	High
WA20.37	Modern feature – not included in CH-002-020	S of Middleton House Farm	418930	296175	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA20.38	Modern feature – not included in CH-002-020	SW of Middleton House Farm	418830	296225	Roughly oval hollow. Probably the remains of a quarry or pond. Visible on LiDAR plots	Undated	Moderate to High
WA20.39	CWM033	North of Bodymoor Heath	419880	296520	Area of probable ridge and furrow on a NNE-SSW alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.40	Modern feature – not included in CH-002-020	W of Pool House Farm	418380	296930	2 roughly oval hollows. Probably the remains of quarries or ponds	Undated.	Moderate to High
WA20.41	Modern feature – not included in CH-002-020	Pool House Farm and Hunts-green Farm	418520	297070	6 ponds. Three to the north west of Pool House Farm, and three to the north of Hunts-green Farm. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High

No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA20.42	CWM037	SE of Middleton	418400	297890	Two roughly oval hollows. Probably the remains of quarries or ponds. Visible on LiDAR plots	Undated	Moderate to High
WA20.43	CWM099	Middleton Hall.	419220	298280	Formal gardens. Landscaped grounds around Middleton Hall, including numerous ponds, areas of parkland and a formal garden. Visible on LiDAR plots	Post-medieval/ Modern	High
WA20.44	Modern feature – not included in CH-002-020	S of Middleton	418060	298200	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA20.45	Modern feature – not included in CH-002-020	NE of Middleton	418115	298910	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA20.46	CWM099	W of Middleton Hall	418930	298350	2 areas of probable ridge and furrow on a NW-SE and N-S alignment. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA20.47	Modern feature – not included in CH-002-020	S of Middleton	417840	298020	3 ponds in the river valley to the south of Middleton. Visible on both Hyperspectral and LiDAR plots	Post-medieval/ Modern	Moderate to High
WA20.48	Modern feature – not included in CH-002-020	N of Park-Gate Farm	418830	298600	Two irregular hollows. Probably the remains of quarries or ponds. Visible on LiDAR plots	Undated.	Moderate to High
WA20.49	Modern feature – not included in CH-002-020	N of Middleton	417900	298825	Large oval hollow. probably a former quarry or pond to the north of Middleton. Visible on LiDAR plots	Undated.	Moderate to High
WA20.50	CWM109	NNW of Park-Gate Farm	418570	299010	Former watercourse. Roughly aligned north east to south west. One section of this still intact. Visible on LiDAR plots	Undated.	Moderate to High
WA20.51	Modern feature – not included in CH-002-020	NNW of Park-Gate Farm.	418470	298970	Irregular hollows. Probably the remains of a quarry or pond. Visible on LiDAR plots	Undated.	Moderate to high
WA5.52	Modern feature – not included in CH-002-020	NNW of Park-Gate Farm.	418620	298900	2 Ponds, both irregular in plan. Possibly the remains of quarries. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High

No	CH-002-020 identifier	Site	Eastings	Northings	Description	Date	Confidence rating
WA5.53	Modern feature – not included in CH-002-020	NE of Upper House Farm	417250	299290	Three large oval hollows. Probably the remains of quarries or ponds. Found on edges of modern fields. Visible on LiDAR plots	Undated.	Moderate to High
WA5.54	Modern feature – not included in CH-002-020	NE of Upper House Farm.	417340	299460	3 Ponds. Two oval and one irregular in plan. Possibly the remains of quarries. On the edge of modern fields. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA5.55	CWM051	NE of Upper House Farm	417185	299205	Series of linear earthworks, probably the remains of former field boundaries or drainage ditches. All lie in the vicinity of the farm complex. Visible on LiDAR plots	Post-medieval/ Modern	Moderate to High
WA5.56	CWM051	NE of Upper House Farm	417260	299220	Areas of probable ridge and furrow on a W-E and N-S alignment. Furrows vary noticeably in width. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High
WA5.57	Modern feature – not included in CH-002-020	Upper House Farm	417225	299175	3 Ponds. All lie in the vicinity of the farm complex. Probably man made. Visible on LiDAR plots	Medieval/post-medieval	Moderate to High

3 Sketch survey

3.1 CNo31 Land south of Middleton House Farm, Tamworth Road, Middleton

Introduction

Project background

3.1.1 Wessex Archaeology was commissioned by Atkins, on the behalf of HS2, to carry out a rapid sketch survey of area CNo31, North Wood, south of Middleton House Farm, Tamworth Road, Middleton (Figure 6), hereafter “the Site” (centred on NGR 419033 295653). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of the proposed development of HS2.

3.1.2 This Site, CNo31, was selected for a rapid sketch survey as it is located in an area of proposed construction works. LiDAR survey identified several topographic features of archaeological potential (Wessex Archaeology 2012). The dense woodland made a geophysical survey impractical.

Site details

3.1.3 The Site comprises a narrow strip of dense woodland (Plate 1), south of Middleton House Farm. It lies approximately 6.5km southwest of Tamworth and 2.6km west of Kingsbury. The limits of the sketch survey area are defined by the extent of the North Wood (5.6 ha) and the field ditches for the surrounding agricultural land. The Site itself was made up of dense woodland divided by a series of trackways (Plate 14) for access. Access to areas beyond the reach of these paths was limited.

3.1.4 The Site is surrounded by agricultural land and sits on a gentle south to north slope. The southern region of the survey area lies at a height of c.72m aOD (above Ordnance Datum) and falls from this height to a little over 68m aOD at the northern edge of the wood. The Site contains several ponds and connecting leats.

Archaeological background

3.1.5 Several areas of archaeological interest have been previously identified and were visible in the LiDAR survey (Figure 6). LiDAR data highlighted potential areas of Ridge and Furrow within the northern half of North Wood (WA20.31). Within the southern half of the wood a series of ponds and connecting leats were visible (WA20.29). Immediately to the north of The Site lies a moated complex made up of two rectangular platforms with a causeway on their northern edge. These platforms being defined by a wide moat. All of these features are presumed to be Medieval in origin with continued use into the post-medieval period (Wessex Archaeology 2012).

Methodology

Survey objectives

3.1.6 A Written Scheme of Investigation (WSI) was prepared by Wessex Archaeology which outlined the aims of the survey and the proposed methodology to be followed (Wessex Archaeology 2013). The stated aims include the following:

- to conduct a detailed survey which covers as much of the specified area as possible,

allowing for artificial obstructions;

- to clarify the presence/absence and extent of any earthworks within the site; and
- to determine the general nature of the remains present and confirm the interpretation suggested by the LiDAR analysis.

3.1.7 This report presents a brief description of the methodology followed, the survey results and the archaeological interpretation of the features identified.

Survey dates

3.1.8 The survey was carried out by Wessex Archaeology between the 2nd and 5th July 2013.

Instruments used and survey method

3.1.9 The sketch survey employed a mixture of measured and photographic survey.

3.1.10 The proposed methodology for the measured survey was to employ a Leica DGPS (Differential Global Positioning System) in RTK (Real Time Kinematics). All earthwork features were to have their tops and bases surveyed in this fashion along with significant breaks of slope.

3.1.11 However, the density of the woodland made this methodology unworkable. No satellites were visible beneath the canopy and no line of site was visible to the edge of the woodland to allow features to be offset against points located with the GPS. As such, the identified earthworks were recorded by local offsets from a 30m hand tape. Localised plans and profiles were produced and the location of features was recorded on appropriately scaled mapping. This approach is comparable to an enhanced level 1 landscape survey (English Heritage 2007).

3.1.12 The photographic survey comprised two-levels of recording. The first level recorded the general character and nature of the Site with the second level made consisting of detailed shots of individual features. The detailed shots contained a 1m or 2m scale bar as appropriate. The location of photographs was recorded on appropriately scaled mapping showing the location and direction of shot.

3.1.13 The photographic record comprised digital photographs taken with a digital SLR camera. The photographic record was made in tandem with the measured survey.

3.1.14 The photographic record comprised digital photographs taken with a digital SLR camera. The photographic record was made in tandem with the measured survey.

Data processing

3.1.15 Any measured survey undertaken with the Leica DGPS was exported as both .DBX and .TXT files. This system employs the Smartnet Corrections service and as such provides a real time accuracy with an average plus or minus of 0.02m. The exported data was subsequently processed within Wessex Archaeology's in house software and exported to AutoCAD (AutoCAD map 3D 2011) as a .DWG file.

Data presentation

3.1.16 This report contains plans showing the location of identified earthworks and features on Ordnance Survey base mapping. Plans and profiles are also included where these enhance the understanding of the feature.

- 3.1.17

Selected photographs from the photographic survey have been included within this report, whilst smaller scale copies of the photographs are incorporated within the accompanying gazetteer.
- Results

Introduction
- 3.1.18

Despite the limited access and visibility across the Site the sketch survey has confirmed the presence of the earthwork features identified by the LiDAR survey of the area (Figure 6).
- 3.1.19

The sketch survey has confirmed the interpretation of the features associated with the pond and leat system within North Wood (features 1-8, 12 and 13) and has added to the understanding of several more ephemeral earthwork features visible in the LiDAR data (features 9, 11 and 14).
- 3.1.20

The only features visible in the LiDAR data and not visible on the ground were the ephemeral ridge and furrow earthworks within the northern half of North Wood (WA5.31). These features were likely to be present based on the accuracy of the LiDAR data elsewhere on Site, however, the dense woodland and thick vegetation made their identification impossible.
- Interpretation: archaeology
- 3.1.21

Feature 1: A large sub circular pond 35m by 37m in width and covering an area of some 1100 square metres (Figure 6). The pond is serviced by leat 8 which in turn connects with leat 6/7 to the south and field boundary 10 to the west. The pond has a small island at its centre which could not be accessed but is approximately 5m wide (Plate 2).
- 3.1.22

Feature 2: A large irregularly shaped pond with ill-defined marshy edges (Plate 3). The feature measures 42m north-south and 24m east-west and covers an area of 693 square metres. Leats are visible on the LiDAR data connecting the pond to field boundary ditch 10 to the east and pond 1 to the west but these could not be investigated due to the density of vegetation around the pond.
- 3.1.23

Feature 3: A large sub circular pond 27m by 24m in width and covering an area of 519 square metres (Plate 4). The edges are ill defined by the intrusion of marshy ground around the feature. The pond is serviced by field boundary ditch 10 to the north and leat 12 to the south.
- 3.1.24

Feature 4: A large oval shaped pond measuring 15m north-south and 51m east-west and covering an area of 631 square metres (Plate 5). The edges are very poorly defined and merge with marshy ground surrounding the feature. The pond is serviced by leat 12 to the north and leat 13 to the south.
- 3.1.25

Feature 5: A large irregular shaped pond measuring roughly 8 m north-south and 52m east-west. The pond has no definable edges and is probably better described as a flooded area at the very southern edge of the wood. The pond is serviced by leat 13 to the north and field boundary 10 to the south.
- 3.1.26

Feature 6: An east-west aligned leat which services ponds 1 and 2 as well connecting the western and eastern extents of field boundary 10 (Plate 6). The western half of the leat is largely silted up (Figure 6) and measures some 1.8m wide and is only 0.15m deep. 121m of the leat's length survives, with its western limit having been backfilled.

- 3.1.27

Feature 7: The same feature as Leat 6. However, the western half of the earthwork survives to a much greater depth immediately to the south of pond 1. At this location the leat measures 2.4m wide and 0.9m deep (Figure 7). The leats western limit has been deliberately backfilled prior to it merging with field boundary 10. The leat was backfilled to allow safe access into the wood along its western edge with the access path running above the leat. This backfilling has been mitigated by the introduction of a plastic drain pipe connecting leat 7 to field boundary 10 to the west.
- 3.1.28

Feature 7: The same feature as Leat 6. However, the western half of the earthwork survives to a much greater depth immediately to the south of pond 1. At this location the leat measures 2.4m wide and 0.9m deep (Figure 7). The leats western limit has been deliberately backfilled prior to it merging with field boundary 10. The leat was backfilled to allow safe access into the wood along its western edge with the access path running above the leat. This backfilling has been mitigated by the introduction of a plastic drain pipe connecting leat 7 to field boundary 10 to the west.
- 3.1.29

Feature 9: A small sub circular pond measuring 6.5m by 9.5m and 53 square metres in area (Plate 8). The pond is not connected to any of the water management earthworks within the wood. The current landowner has suggested that the feature may be a Second World War bomb crater.
- 3.1.30

Feature 10: A large field boundary ditch defining the edges of North Wood (Plate 9). The ditch is 3.2m wide and survives to a depth of 0.9m (Figure 9). Leats 6, 7, 8 all drain into feature 10 which itself connects with a moated complex (WA5.33) immediately to the north of the wood.
- 3.1.31

Feature 11: A temporary camp used for woodland management roughly circular in shape and covering an area 10m by 5m (plate 10). The camp has no cut features and does not appear in the LiDAR data.
- 3.1.32

Feature 12: A north-south aligned leat connecting ponds 3 and 4 (Plate 11). The feature measures 2.8m wide and survives to a depth of 0.9m (Figure 10). The leat runs for 31m.
- 3.1.33

Feature 13: A north-south aligned leat connecting ponds 4 and 5 (Plate 12). The feature measures 2.5m wide and only survives as a shallow depression due to a significant amount of silting. The leat runs for 34m.
- 3.1.34

Feature 14: A small oval shaped pond measuring 9.5m by 4m and covering an area of 39 square metres (Plate 13). The pond is not connected to any of the water management earthworks within the wood. The pond is presumed to be the remains of a Second World War bomb crater as suggested by the land owner with feature 9.
- Conclusions

Introduction
- 3.1.35

The sketch survey has confirmed the presence of the pond and leat (WA20.31) system identified in the LiDAR data and provided a more detailed understanding of the present condition of these surviving earthworks. The dense woodland and limited access made the identification of proposed ridge and furrow in the northern half of the Site (WA20.29) impossible to detect. The features identified would support the idea that the ponds and leats within North Wood provided a water supply for the Medieval moated complex (WA20.33) situated immediately north of the Site.

Discussion

- 3.1.36

The pond and leat system identified in the LiDAR interpretation as WA5.29 are readily visible on the ground. Ponds 1-5 are clearly identifiable as a series of shallow water features with poorly defined edges. The connecting leats (features 6/7, 8, 12, 13) and field boundary defining the extent of the wood (feature 10) all survive intact. The leats survive to an average depth of 0.5m to 0.9m and width of c.2m. The field boundary survives to an average depth of 1m and a width of 2.5m. Only one of the leats has been partially backfilled (feature 6/7). West-east leat 6/7 would have at one point connected with field boundary 10 to the south west of pond 1. This area of the leat has been backfilled (presumably due to its proximity to the path accessing the wood from the west). The eastern extent of this leat has silted up almost to its full height. By the time it reaches the area immediately south of pond 2 it is only just visible as a muddy depression in the ground.
- 3.1.37

This entire water system is likely to be Medieval in origin and served to irrigate the moated complex situated immediately to the north of the wood (WA5.33) The ponds would have drained into the leats which are themselves connected to the field boundary ditches defining the wood. This field boundary ditch (feature 10) itself connects to the large ditches of the moat that defines WA5.33. The natural south-north slope of the landscape would have allowed gravity to transport the water from the pond system to the moats.
- 3.1.38

Two additional small ponds were also identified during the sketch survey. Features 9 and 14 are significantly smaller than the ponds identified in the LiDAR interpretation provided prior to undertaking the sketch survey. Whilst visible in the LiDAR data they were not identified as ponds. Discussions with the landowner indicate that they are likely to be Second World War bomb craters and are not associated with the medieval water system within North Wood.
- 3.1.39

The only other identifiable features related to the woods use in the 20th and 21st centuries. A small camp was identified (feature 11) located to the south of pond 1 and near the western access route to North Wood. This camp appears to serve as a temporary shelter for present day woodland management and presumably has been in use for the last few decades. No earthworks are associated with this camp.
- 3.1.40

The sketch survey has highlighted the accuracy of the LiDAR survey even under the canopy of a dense woodland. All of the features identified in the LiDAR interpretation were present on the ground. The only additional earthwork features identified in the sketch survey were visible in the LiDAR data but not specifically highlighted as significant in the LiDAR interpretation. The only feature not identified was the ridge and furrow in the north of the wood (WA5.31). Access was problematic due to the density of the woodland but given the accuracy of the LiDAR data elsewhere on Site it seems likely that the ridge and furrow was present but not visible. A follow up visit in winter with reduced canopy and ground vegetation may allow the identification of these earthworks.

References

Bibliography





English Heritage (2007), *Understanding the Archaeology of Landscapes*. A guide to good recording practice.




Wessex Archaeology (2012), *LiDAR analysis: Community Forum Area 22 (Whittington to Handsacre)*.





Wessex Archaeology (2012), *LiDAR analysis: Community Forum Area 20 (Curdworth to Middleton)*.

Wessex Archaeology (2013), *HS2 Method Statement for Field Survey*. Report reference 86254.54.



Gazetteer of identified features

Feature ID	Description	NGR	
1	Large Medieval/Post-medieval pond measuring 35m by 37m	419002, 295660	
2	Large Medieval/Post-medieval pond measuring 42m by 24m	419055, 295643	
3	Large Medieval/Post medieval pond measuring 26m by 24m	418978, 295544	
4	Large Medieval/Post medieval pond measuring 51m by 15m	418984, 295488	

Feature ID	Description	NGR	
5	Large Medieval/Post medieval pond measuring 52m by 8m.	418971, 295455	
6	East-west aligned leat servicing ponds 1 and 2	419066, 295613	
7	East-west aligned leat servicing ponds 1 and 2	419005, 295629	

Feature ID	Description	NGR	
8	North-south aligned leat servicing pond 1	419008, 295701	
9	Small pond. Probable Second World War bomb crater	419009, 295753	
10	Field boundary defining the extent of North Wood	418971, 295637	
11	Modern day camp for woodland management	418982, 295608	

Appendix CH-004-020 | Sketch survey

Feature ID	Description	NGR	
12	North-south aligned leat servicing ponds 3 and 4	418977, 295516	
13	North-south aligned leat servicing ponds 4 and 5	418997, 295463	

Feature ID	Description	NGR	
14	Small pond. Probable Second World War bomb crater	419017, 295525	

Figures

Figure 6: Plan of identified features



Figure 7: Plan and profile through feature 7

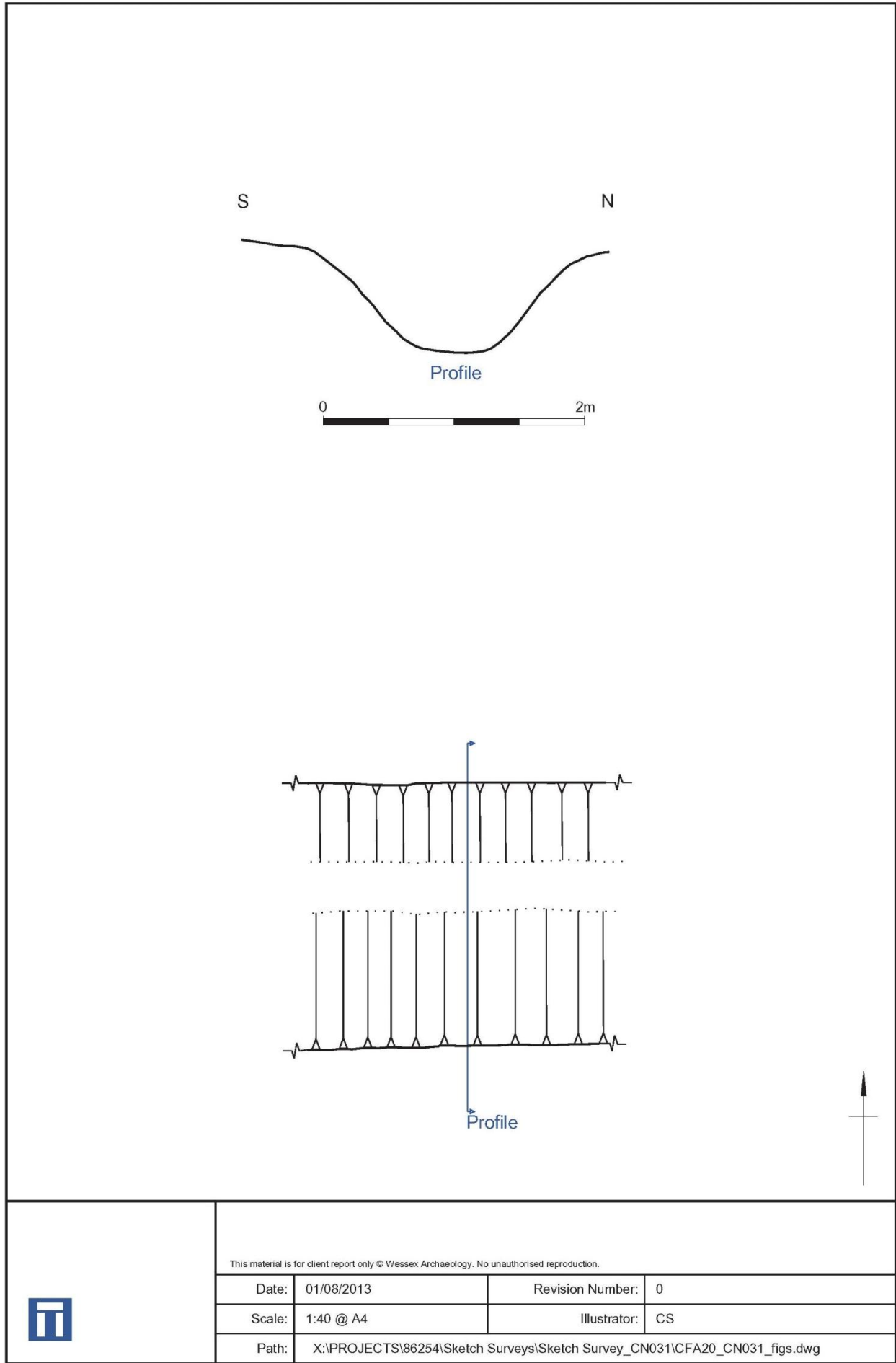


Figure 8: Plan and profile through feature 8

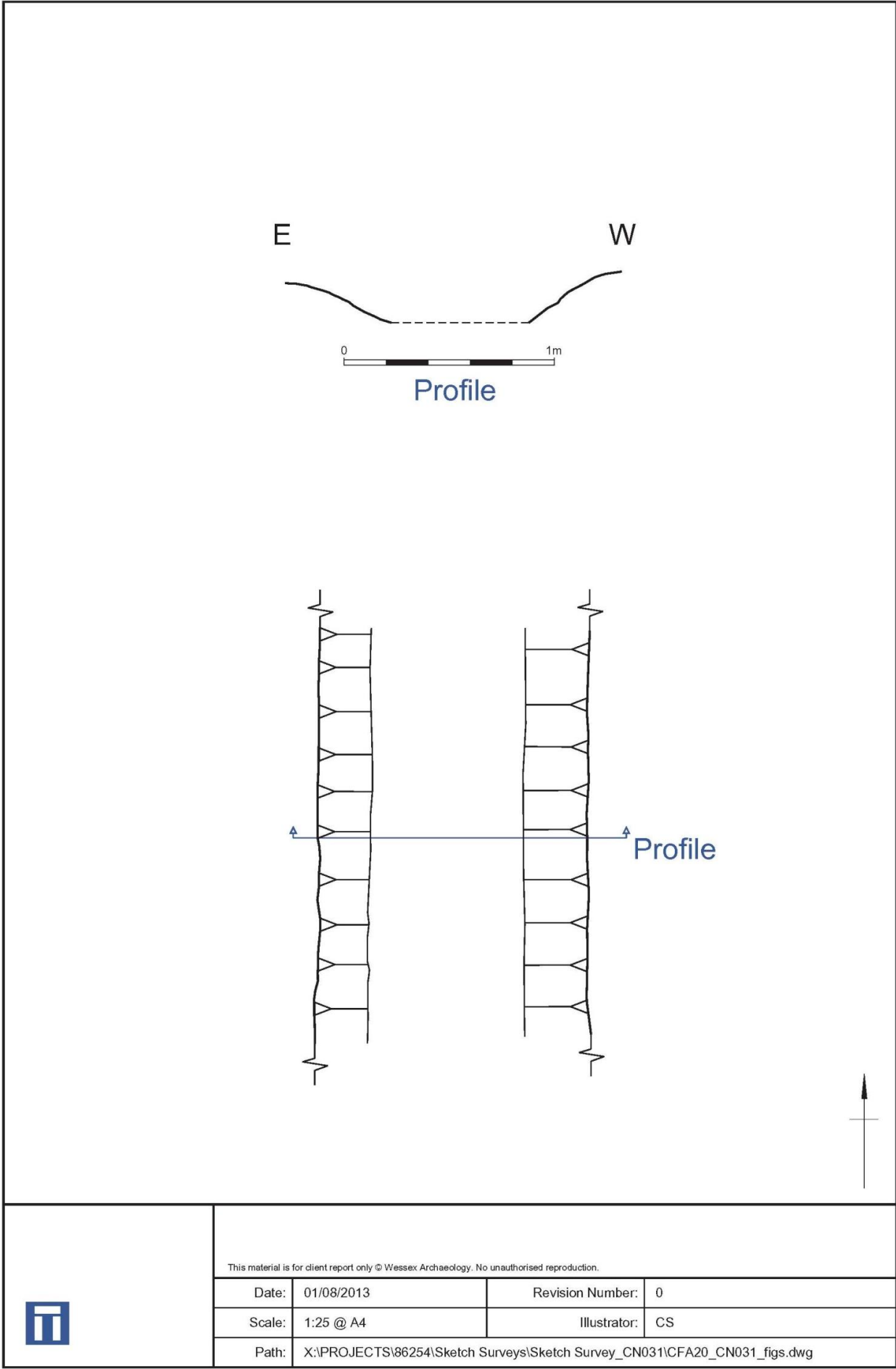


Figure 9: Plan and profile through feature 10

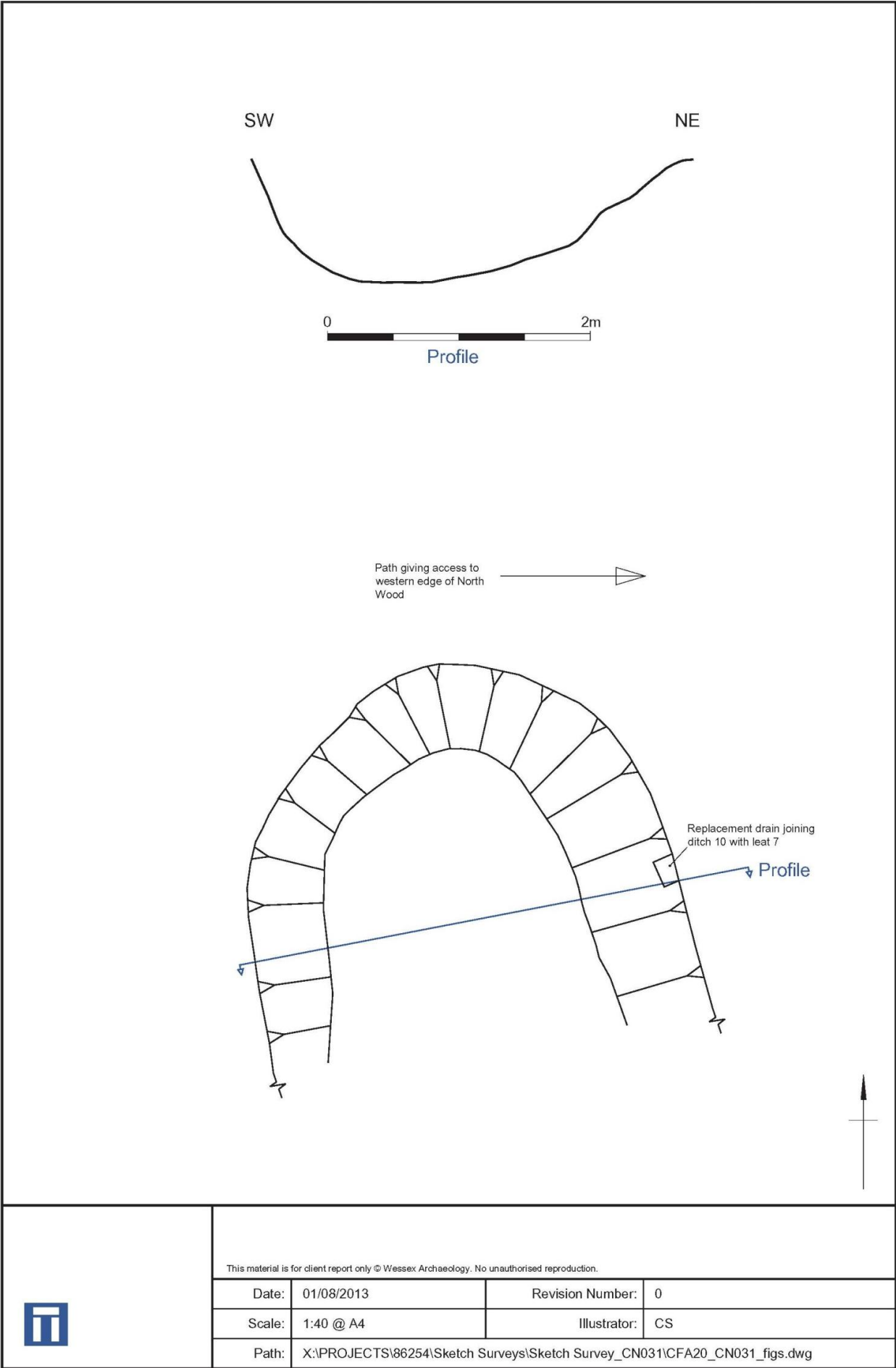
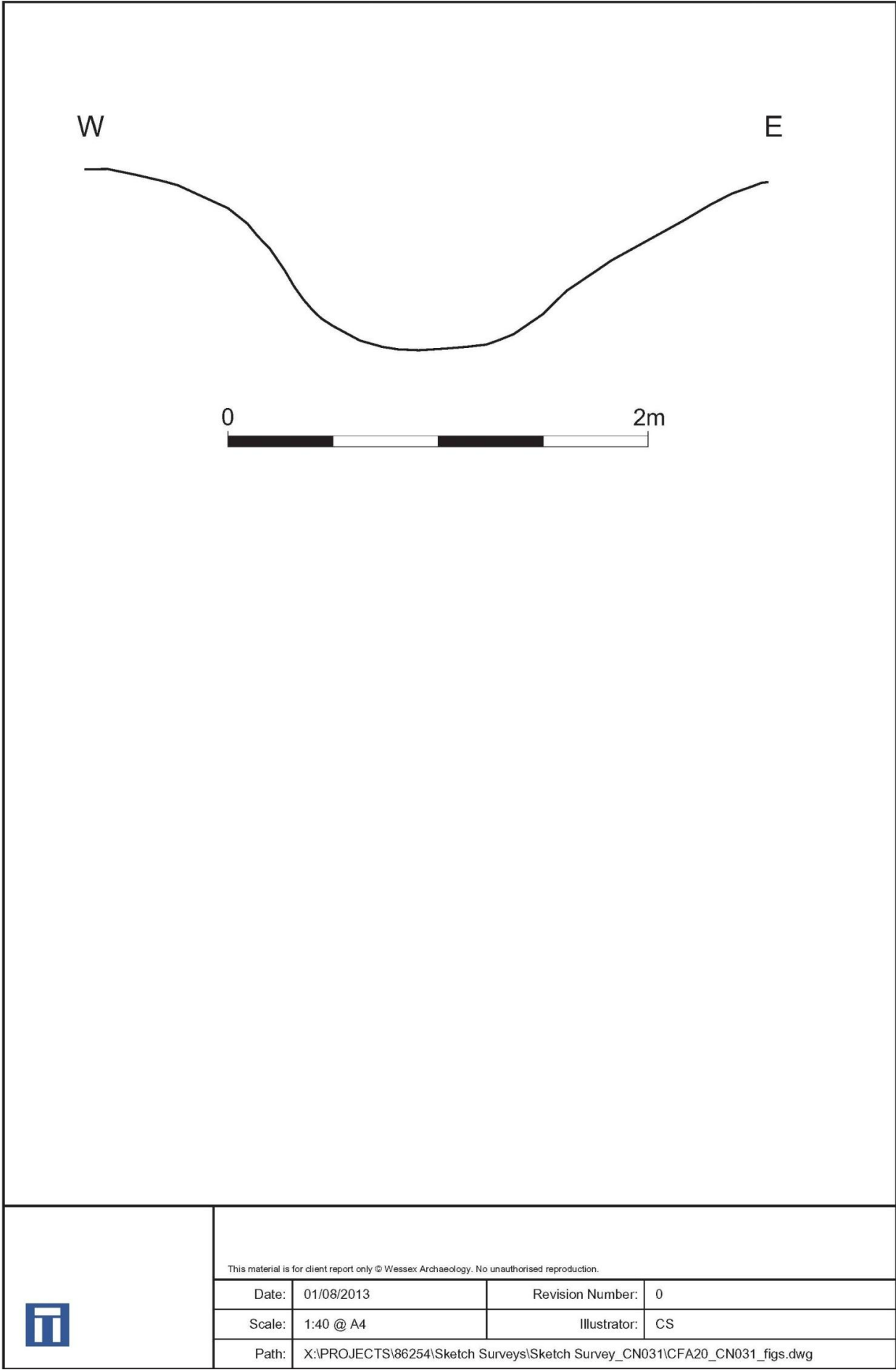


Figure 10: Plan and profile through feature 12



Plates



Plate 1: General shot of western edge of North Wood, facing north



Plate 2: Feature 1. General shot of pond, facing east



Plate 3: Feature 2. General shot of pond, facing north



Plate 5: Feature 4. General shot of pond, facing southwest



Plate 4: Feature 3. General shot of pond, facing south



Plate 6: Feature 6/7. East west aligned leat, shot facing east



Plate 7: Feature 8, east facing shot of leat



Plate 9: Feature 10. Field boundary ditch surrounding north wood, facing east



Plate 8: Feature 9. Pond/Second World War bomb crater, facing west



Plate 10: Feature 11. Modern day camp associated with woodland management, facing north



Plate 11: Feature 12. North-south aligned leat, facing south



Plate 13: Feature 14. Pond/Second World War bomb crater, facing east



Plate 12: Feature 13. North-south aligned leat, facing west



Plate 14: Path providing access to North Wood along its western edge, facing east

4 Geophysical surveys

4.1 CNo27 Land off Faraday Avenue, near Curdworth, Warwickshire

Introduction

Project background

4.1.1 Wessex Archaeology was commissioned by Atkins, on the behalf of HS2, to carry out a geophysical survey of area CNo27 off Faraday Avenue, near Curdworth, Warwickshire (Figure 11), hereafter “the Site” (centred on NGR 419000 292250). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of the proposed development of HS2.

4.1.2 This Site, CNo27, was selected for geophysical survey as it is located in an area close to known cropmarks and a possible rail head. It is considered to be an area at high risk (risk model score: 2).

Site details

4.1.3 The Site comprises one arable field located off Faraday Avenue, southwest of an electrical substation off Hams Lane. The Site lies approximately 1.2km southeast of the centre of Curdworth and 12.4km ENE of the centre of Birmingham. The limits of the geophysical survey area are defined by field boundaries for much of the area with the southern limits defined by the edge of an area of potato crop. The Site comprises one arable field split into two areas of crop; the northern half of the field was under a young cereal crop and the southern half of the field was under a young potato crop planted in tall ridges. Geophysical survey was undertaken over the area of cereal crop but not over the area of potato crop; this was due to concerns with the deterioration in data quality of working on the ridged, uneven ground. The area of data coverage came to around 5.7ha.

4.1.4 The Site lies on the southwest facing slope of a gently sloping hill, the highest area of the hill lies further to the north with another slightly smaller hill located to the west. The northeast region of the survey area lies at a height a little over 80m aOD (above Ordnance Datum) and falls from this height to a little under 75m aOD at the southwest corner of the Site. The highest point in the local area is located near Dunton Hall (100m aOD). There is one watercourse, an unnamed brook, which flows close to the south of the Site and flows into the River Tame.

4.1.5 The solid geology is recorded as Keuper marl (Triassic) (Ordnance Survey 1957). The superficial deposits recorded on Site and close by are river terrace deposits, alluvium and glacial deposits (Ordnance Survey 1977). The soils underlying most of the Site are likely to be gleyic brown earths of the 543 (Arrow) association. The eastern edge of the site was not surveyed by the soil survey as it was considered to be largely urban or industrial (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

Archaeological background

4.1.6 There are no records of archaeological sites within the survey area. Sites located within 1km of the survey area will be discussed; for a full account of the recorded heritage assets the appropriate Desk-Based Assessment (DBA) should be consulted.

4.1.7 There is one undated site to the north of the survey area which is very close; it is a group of cropmarks observed on Aerial Photographs (APs) including a ring ditch and linear features. The ring ditch is recorded as oval in shape and fairly faint and the northern linear is thought to look geological (MWA12046).

4.1.8 There are no records relating to the Palaeolithic, Mesolithic, Neolithic or Iron Age within 1km of the survey area. The only prehistoric records in the vicinity date to the Bronze Age and include a find of an Early Bronze Age finished axe (EH332058) and a Middle Bronze Age palstave (EH332068), both found in the north of Curdworth (northwest of the survey area). Another palstave axe (bronze) was found to the west of the survey area and is recorded as unlooped with a shield pattern, the location for this findspot is uncertain (MWA47).

4.1.9 Only one record dating to the Romano-British period lies within 1km of the survey area. A single sherd of Romano-British moratorium was discovered to the northwest of the site when the M42 was constructed (MWA4882). There are no post-Roman or Anglo-Saxon records within 1km of the survey area.

4.1.10 The medieval records are concentrated around and within Curdworth. The village is listed in Domesday in the Coleshill Hundred. First edition maps suggest that the village may have shrunk in the medieval with empty plots recorded (MWA9509). The church of St. Peter and St. Nicholas in Curdworth has its origins in the medieval with parts of the building dating to the 11th century. Other parts of the building were restored in the 19th century (MWA41). A record of a possible medieval cross is situated 20m south of the church; it was thought to have been brought in from elsewhere and was not local. It was destroyed by vandalism during the Second World War (MWA42).

4.1.11 Immediately to the northeast of Curdworth are the remains of a moated site thought to date to the medieval. Three arms of the moat are visible although it is now dry; this moat is considered to represent the site of a manor house although no trace has been found within (MWA43 and MWA6227). There are two records of possible ridge and furrow around Curdworth (MWA9098 and MWA12047).

4.1.12 The post-medieval and modern records located within 1km of the survey area mostly relate to industrial activity or were devoted to parkland and agriculture. The area to the east of the site was occupied by park/gardens of Ham Hall; the original house was re-built c.1768 but the site is thought to date to the earlier post-medieval period. The gardens and hall were demolished in 1920 and the area became the site of a power station (MWA12547). Records of two bridges are located to the southwest of the survey area; both are known as Curdworth Bridge. The earlier bridge dates to the 16th century and lies upstream of the current bridge although no trace of it can be seen today (MWA51). The current bridge was erected in the 19th century about 50 yards from the earlier one (MWA52).

4.1.13 To the north of the survey area is a windpump that is recorded on the Ordnance Survey map of 1901 (MWA6610). Dunton Hall lies further north and dates to the late 17th century, a barn and a dovecote (late 17th or early 18th century) are also associated with the hall and all are Grade II listed (MWA44 and MWA45). To the east of Dunton hall are the remains of a number of charcoal manufacturing sites that appear as roughly circular soil marks on APs (MWA12038).

4.1.14 An undated pit was discovered east of Curdworth during construction of the Birmingham Northern Relief Road; it contained a few flecks of charcoal but no finds (MWA9099).

Methodology	
<i>Survey objectives</i>	
4.1.15	<p>A Written Scheme of Investigation (WSI) was prepared by Wessex Archaeology which outlined the aims of the survey and the proposed methodology to be followed (Wessex Archaeology 2013). The stated aims include the following:</p> <ul style="list-style-type: none">• to conduct a detailed survey which covers as much of the specified area as possible, allowing for artificial obstructions;• to clarify the presence/absence and extent of any buried archaeological remains within the site; and• to determine the general nature of the remains present.
4.1.16	<p>This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.</p>
<i>Survey dates</i>	
4.1.17	<p>A detailed gradiometer survey was carried out by Wessex Archaeology's in-house geophysics team on 22nd May 2013.</p>
<i>Grid location</i>	
4.1.18	<p>The individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (EH 2008).</p>
4.1.19	<p>A representative sample of survey grid nodes (around 10%) were re-surveyed in the mornings in the event they were left out in the field overnight. This was undertaken along with a visual inspection of entire lines of grid nodes to ensure the survey grid remained accurate for the entire survey.</p>
<i>Instruments used and survey method</i>	
4.1.20	<p>The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (EH 2008).</p>
4.1.21	<p>Data were collected in the zigzag method with grids oriented north to south (Grid North). The first direction walked for each grid was heading towards the north.</p>
<i>Data processing</i>	
4.1.22	<p>Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse (ZMT) function (± 7nT thresholds for most grids) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. The multiply function was applied to selected grids to balance out differences in background texture that resulted from collecting some grids at different heights to others. The deslope function was used to correct errors that resulted from imperfections in the ZMT function. These four steps were applied to all survey data, with no interpolation applied.</p>
4.1.23	<p>Further details of the geophysical and survey equipment, methods and processing are described in Appendix 1.</p>
<i>Data presentation</i>	
4.1.24	<p>The processed gradiometer data were output as .png image files and georeferenced in CAD (AutoCAD Map 3D 2011); these images were exported as georeferenced .png image files (accompanied by .pgw files). The interpretation layers were digitised in CAD and the resulting interpretation layers were exported as ESRI shapefiles, in accordance with the specification. The data images and interpretation shapefiles were then passed to our graphics team who produced the final figures in GIS (ESRI ArcMap 10).</p>
4.1.25	<p>The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ± 25nT at 25nT per cm for the XY trace plots. The XY trace plot images have been produced at a scale of 1:1500.</p>
Results	
<i>Introduction</i>	
4.1.26	<p>The gradiometer survey has been successful in identifying anomalies of likely and possible archaeological interest, along with numerous trends and two modern services. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (Figures 12 to 14).</p>
4.1.27	<p>The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (Figure 14). Full definitions of the interpretation terms used in this report are provided in Appendix 2.</p>
4.1.28	<p>Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.</p>
<i>Interpretation: archaeology</i>	
4.1.29	<p>There are few anomalies of likely archaeological interest within the survey area; the majority form part of an L-shaped arrangement of features formed of ditch-like anomalies, ferrous anomalies and areas of increased magnetic response. The linear positive anomalies at 4000 and 4001 form the clearest features with magnetic values over +2nT; there are also weaker linear features such as at 4002 with values less than +2nT. These features are considered to represent ditches and appear to partly define a former field boundary visible on early Ordnance Survey (OS) maps. This field boundary was removed sometime between 1967 and 1982 (Ordnance Survey 1982 and 1967).</p>
4.1.30	<p>The only other anomaly of likely archaeological interest is located at 4003; this feature is sub-oval in plan, measures 3.2m in length and has magnetic values over +3nT. This anomaly is considered to represent a cut feature such as a pit.</p>
4.1.31	<p>There are numerous agricultural features visible in the data including ploughing trends at 4004 and ceramic field drains at 4005. The remaining trends are considered to be of uncertain origin as they are set at different alignments to the ploughing and have differing forms. The curving trend at 4006 may prove to be archaeological but could also be a turn in the ploughing direction. There are two parallel linear trends at 4007 that are clearly not related to modern</p>

ploughing although their identity is unclear from the geophysical data. Both of the examples above have been classified as uncertain origin due to uncertainties in their interpretation.

- 4.1.32 The remaining anomalies of possible archaeological interest are numerous small sub-oval positive responses such as those close to the west of 4008. They typically have values over +1.5nT and are considered to either represent cut features such as small pits and postholes or are geological features. It is not possible to be more definite in the interpretation as these features form no significant patterning in their spatial distribution.
- 4.1.33 There are concentrations of ferrous responses accompanied by spreads of increased magnetic response in the data, as at 4009. These spreads are not considered to be archaeological and are likely to be formed of relatively modern metallic and ceramic debris that have either been dumped on the land or deliberately spread during agricultural activity.
- 4.1.34 There are two services visible in the data at 4010; these features are discussed in more detail below.
- 4.1.35 The remaining anomalies are broad, weakly positive regions with very diffuse edges such as at 4011; given their form these features are considered to be geological and have been classified as natural.

Interpretation: modern services

- 4.1.36 Two modern services have been identified in the data close to 4008; these services appear to be metallic/ceramic pipes. The larger of the two pipes (larger in terms of anomaly size in plan) runs roughly north-south through the southwest corner of the field and the second extends perpendicular from the larger one and heads east into the middle of the field. Both services run beyond the extents of the survey area and most likely continue further into unsurveyed areas of this field.
- 4.1.37 It is not clear from the geophysical data whether the services identified are in active use or not. Also gradiometer data will not be able to locate and identify all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

Conclusions

Introduction

- 4.1.38 The detailed gradiometer survey has been successful in detecting anomalies of likely and possible archaeological interest within the Site, in addition to regions of increased magnetic response, numerous trends of uncertain origin and at least two modern services.

Discussion

- 4.1.39 The data shows few likely archaeological anomalies and most of these are likely to relate to a relatively modern field boundary. No features were identified that might relate to the cropmarks identified further north. Only one pit-like response was identified at 4003.
- 4.1.40 This field has clearly been covered with a lot of strongly magnetised debris. This debris has magnetic values that are high enough to mask the weaker responses expected from archaeological features. This has reduced the area in which archaeological features are visible, especially around services and field edges. It may be that more archaeological features are present than were detected in the geophysical data presented in this report.

- 4.1.41 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; it is assumed that the centreline of services is coincident with the centreline of their anomalies. It is difficult to estimate the depth of burial of the services through gradiometer survey.

- 4.1.42 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey. Given how weak many of the features interpreted in this data are it seems very likely that more features may be present than were detected during the survey.

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Wessex Archaeology (2013), *HS2: Geophysical Survey Written Scheme of Investigation*. Report Reference: 86254.01.

HER records consulted

MWA41 – Church of St. Peter and St. Nicholas, Curdworth

MWA42 – Site of possible medieval cross at Curdworth

MWA43 – Moat at Curdworth Hall Farm

MWA44 – Dunton Hall, Curdworth

MWA45 – Dunton Hall Dovecote, Curdworth

MWA47 – Findspot, Bronze Age axehead in the parish of Curdworth

MWA51 – Curdworth Bridge, remains of

MWA52 – Curdworth Bridge

MWA4882 – Findspot, Roman pottery sherd

MWA6227 – Site of manor house at Curdworth Hall Farm

MWA6610 – Site of windpump S of Dunton Hall

MWA9098 – Linear features, east of Curdworth Hall Farm, Curdworth, Warwickshire

MWA9099 – Pit, east of Curdworth Hall Farm, Curdworth, Warwickshire

MWA9509 – Curdworth Medieval Settlement

MWA12038 – Charcoal manufacturing sites in Curdworth Parish

MWA12046 – Ring ditch and linear features in Curdworth Parish

MWA12047 – Ridge and furrow in Curdworth Parish

MWA12547 – Hams Hall park/garden, Lea Marston

English Heritage PastScape records

Monument No. 332058 – Findspot, Early Bronze Age finished axe (EH332058)

Monument No. 332068 – Findspot, Middle Bronze Age palstave (EH332068)

Figures

Figure 11: Site location

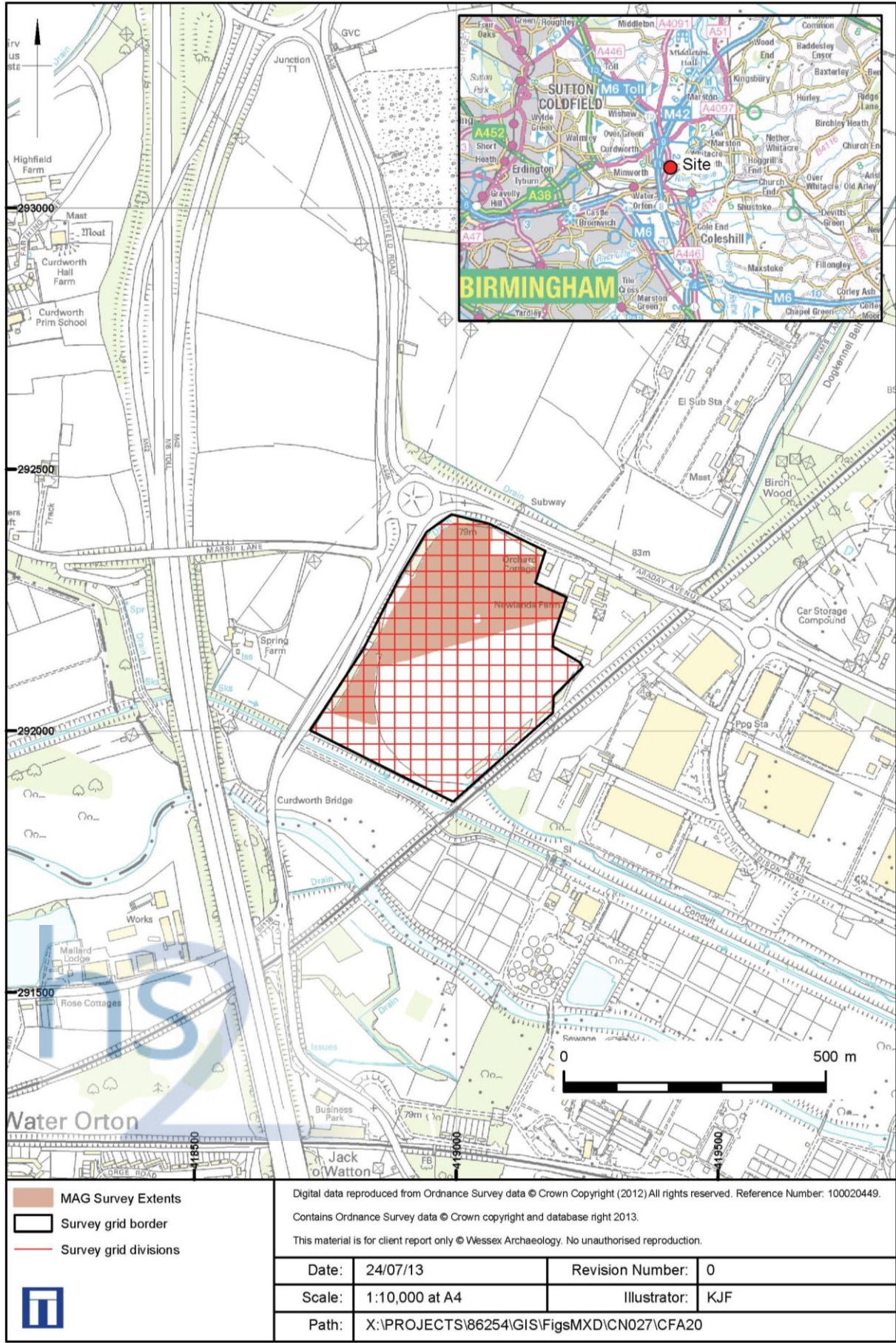


Figure 12: Greyscale plot

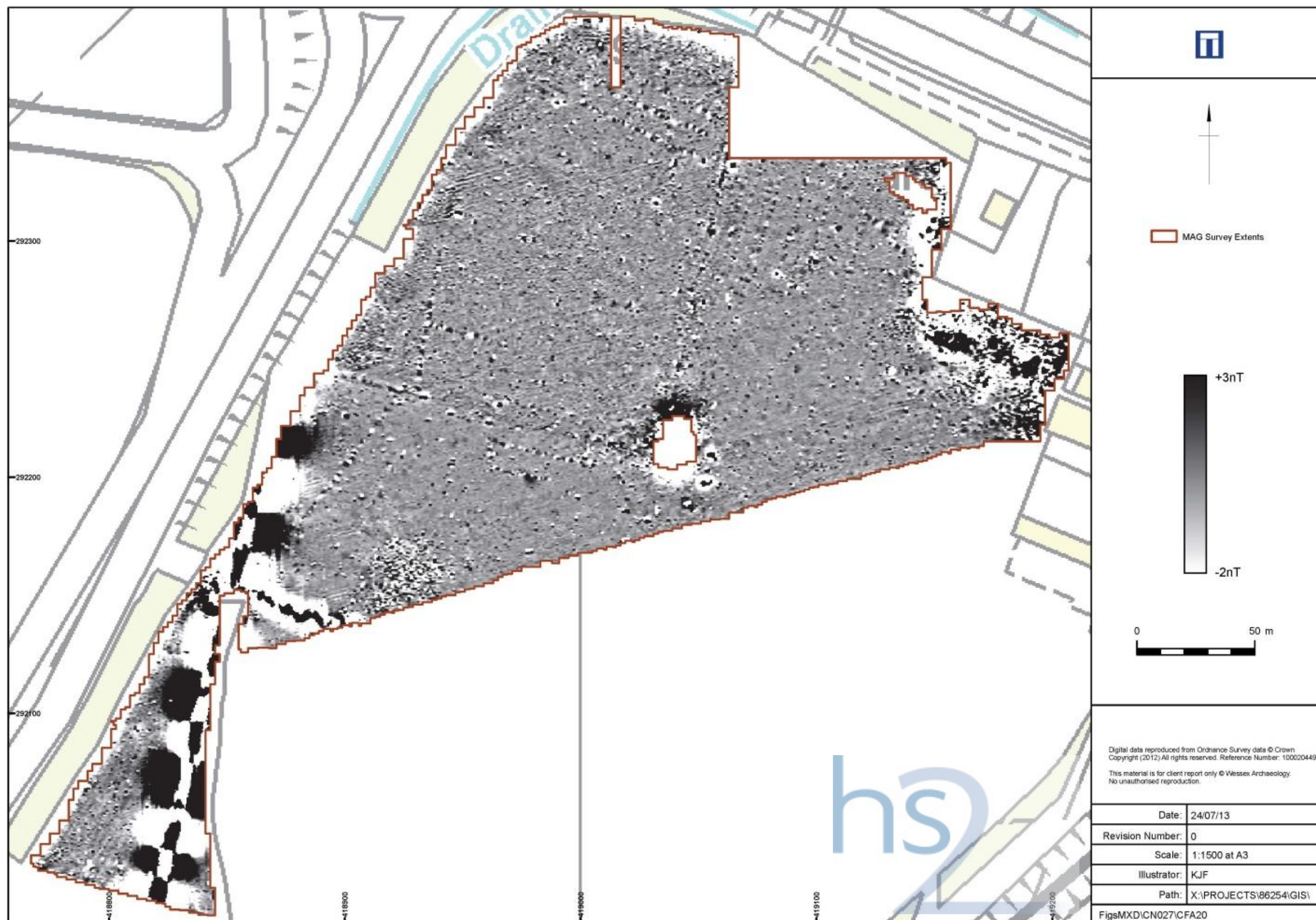


Figure 13: XY trace

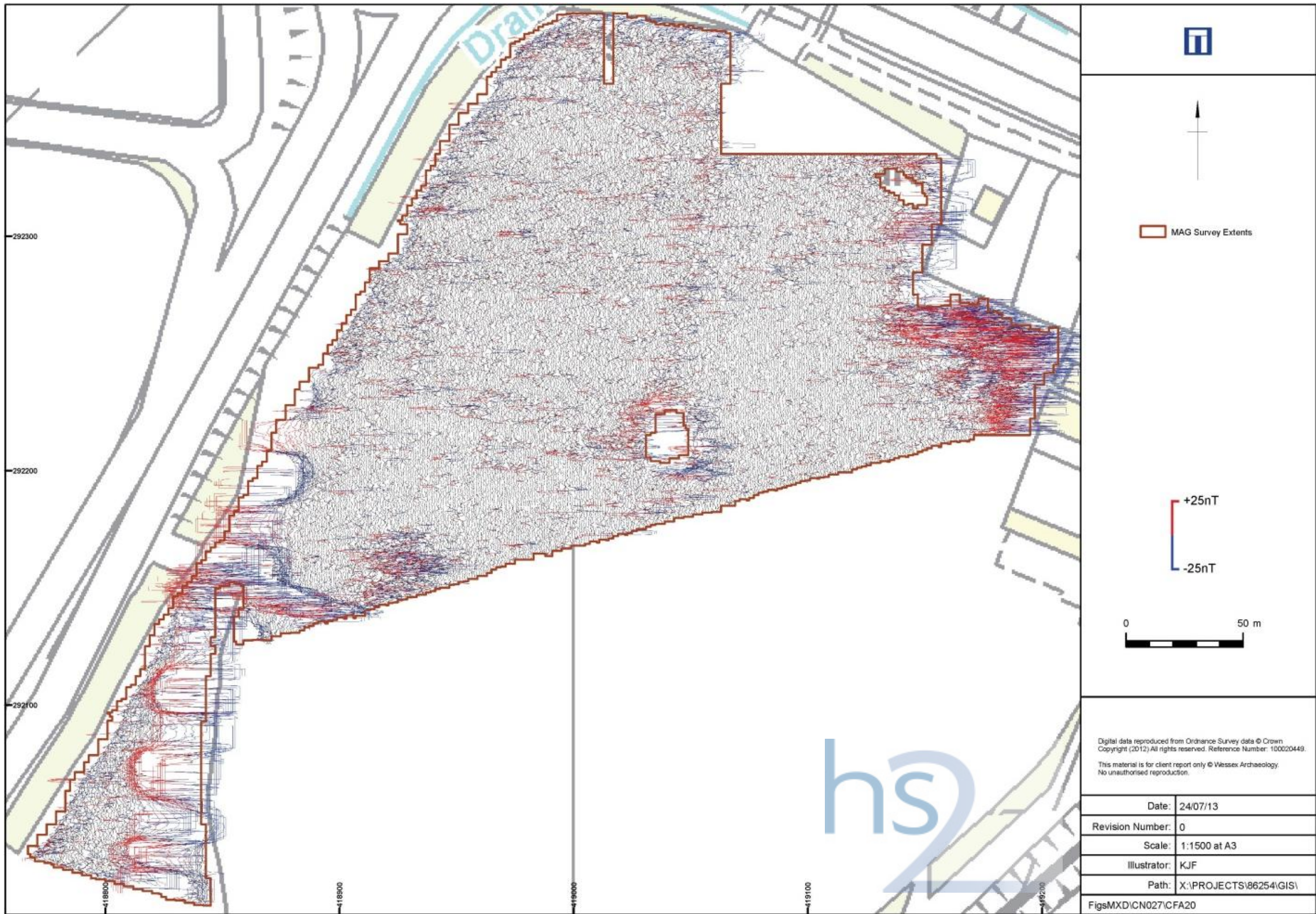
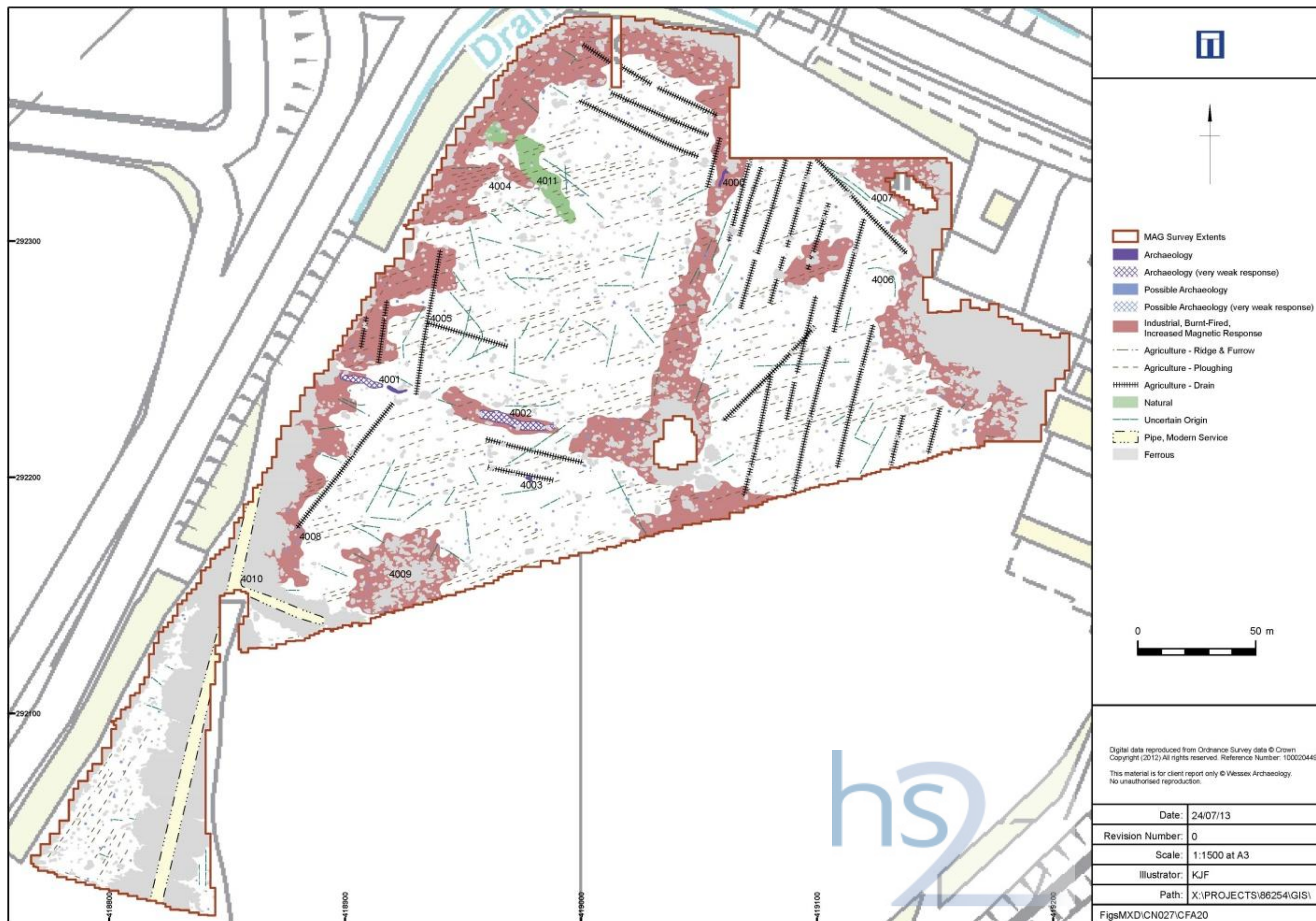


Figure 14: Interpretation



4.2 CNo29 Land off Lichfield Road and Faraday Road, near Curdworth, Warwickshire

Introduction

Project background

- 4.2.1
- Wessex Archaeology was commissioned by Atkins, on the behalf of HS2, to carry out a geophysical survey of area CNo29 off Lichfield Road (A449) and Faraday Avenue, near Curdworth, Warwickshire (Figure 15), hereafter “the Site” (centred on NGR419070 292635). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of the proposed development of HS2.
- 4.2.2
- This Site, CNo29, was selected for geophysical survey as it is close to known archaeological remains. It is considered to be an area at medium risk (risk model score: 2/3).

Site details

- 4.2.3
- The Site comprises four fields located off Lichfield Road (A449) and Faraday Avenue and lies approximately 1km east of the centre of Curdworth. The limits of the geophysical survey area are defined by modern field boundaries for much of the area. There are roads to the west and south of the survey area, a lane to the east and field boundary to the north.
- 4.2.4
- The Site lies on an area of gently sloping land that falls away towards the southeast. The northwest region of the survey area lies at a height a little over 100m aOD (above Ordnance Datum) and falls from this height to less than 100m aOD at the southeast corner of the Site.
- 4.2.5
- The solid geology is recorded as Keuper marl (Triassic) (Ordnance Survey 1957). The superficial deposits recorded on Site and close by are river terrace deposits, alluvium and glacial deposits (Ordnance Survey 1977).
- 4.2.6
- The soils underlying most of the Site are likely to be gleyic brown earths of the 543 (Arrow) association. The eastern edge of the site was not surveyed by the soil survey as it was considered to be largely urban or industrial (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

Methodology

Survey objectives

- 4.2.7
- A Written Scheme of Investigation (WSI) was prepared by Wessex Archaeology which outlined the aims of the survey and the proposed methodology to be followed (Wessex Archaeology 2013). The stated aims include the following:
 - to conduct a detailed survey which covers as much of the specified area as possible, allowing for artificial obstructions;
 - to clarify the presence/absence and extent of any buried archaeological remains within the site; and
 - to determine the general nature of the remains present.
- 4.2.8
- This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

Survey dates

- 4.2.9
- A detailed gradiometer survey was carried out by Wessex Archaeology's in-house geophysics team between 17th and 21st May 2013.

Grid location

- 4.2.10
- The individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (EH 2008).
- 4.2.11
- A representative sample of survey grid nodes (around 10%) were re-surveyed in the mornings in the event they were left out in the field overnight. This was undertaken along with a visual inspection of entire lines of grid nodes to ensure the survey grid remained accurate for the entire survey.

Instruments used and survey method

- 4.2.12
- The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (EH 2008).
- 4.2.13
- Data were collected in the zigzag method with grids oriented north to south (Grid North). The first direction walked for each grid was heading towards the north.

Data processing

- 4.2.14
- Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse (ZMT) function (± 7 nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey data, with no interpolation applied.
- 4.2.15
- Further details of the geophysical and survey equipment, methods and processing are described in Appendix 1.

Data presentation

- 4.2.16
- The processed gradiometer data were output as .png image files and georeferenced in CAD (AutoCAD Map 3D 2011); these images were exported as georeferenced .png image files (accompanied by .pgw files). The interpretation layers were digitised in CAD and the resulting interpretation layers were exported as ESRI shapefiles, in accordance with the specification. The data images and interpretation shapefiles were then passed to our graphics team who produced the final figures in GIS (ESRI ArcMap 10).
- 4.2.17
- The gradiometer data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ± 25 nT at 25nT per cm for the XY trace plots. The XY trace plot images have been produced at a scale of 1:2000.

Results

Introduction

- 4.2.18
- The gradiometer survey has been successful in identifying anomalies of likely and possible archaeological interest, along with numerous trends. Results are presented as a series of

	greyscale and XY plots, and archaeological interpretations, at a scale of 1:2000 (Figures 16 to 21).		
4.2.19	The interpretation of the dataset highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (Figures 18 and 21). Full definitions of the interpretation terms used in this report are provided in Appendix 2.	4.2.28	The largest field to the west contains the greatest number of archaeological features including a number of linear features along with a few sub-oval positive anomalies. There are three sub-oval shaped pit-like anomalies at 4009 and 4010; they have magnetic values over +3nT and are considered to be of likely archaeological interest.
4.2.20	Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.	4.2.29	Two linear anomalies are present at 4011 and 4012 with varying magnetic values along their length, typically less than +2nT. These features are not aligned with the present field boundaries so may prove to be ditches forming part of an earlier field system.
	<i>Interpretation: archaeology</i>	4.2.30	Another two positive linear features are present at 4013 and 4014, they have weak values less than +2nT but are aligned with the present field boundary. The linear at 4013 is closely aligned with a change in the crop that was visible during the survey; these features are likely to be fairly modern and have been classed as possible archaeology to reflect this.
4.2.21	The easternmost field contains a great concentration of ferrous along with a few anomalies considered to be of likely archaeological interest. An L-shaped positive anomaly with values over +3nT is present at 4000; it is considered to represent a cut feature such as a ditch but little more can be said as the area surrounding it is dominated by ferrous responses. There are more positive responses (over +3nT) around 4001 and 4002 that are sub-oval or elongated in shape; these are considered to either represent short ditch sections or pits but are again located in an area dominated by ferrous responses. Another L-shaped anomaly is present at 4003 with similar values to those of 4000 and is considered to be a short section of ditch. These features are considered to be archaeological but it is likely that there are other features present in this field that are obscured by the wide spreads of ferrous in this field.	4.2.31	There are numerous trends in the data, some clearly relate to ploughing scars such as 4016 but others may prove to be archaeological such as those at 4015. There are strong bipolar linear anomalies running through the data such as the concentration at 4017; these are considered to represent ceramic field drains.
4.2.22	There is a spread of dipolar and bipolar anomalies at 4004 that are interpreted as increased magnetic response. This area may be geological but is perhaps more likely to represent a spread of ceramic/ferrous debris.	4.2.32	There are several concentrated spreads of bipolar and dipolar anomalies that have been classed as increased magnetic response such as at 4018. These spreads are likely to represent concentrations of ceramic/ferrous material, possibly of fairly recent date.
4.2.23	A junction between two services is visible at 4005; these services are believed to be cables and will be discussed in more detail in the next section of the report.	4.2.33	There are three pylons visible in the data at 4019, 4020, 4021 and 4024; a pipe is visible at 4022 and 4023 and a possible cable is visible at 4024. These services will be discussed in the next section of the report.
4.2.24	The remaining anomalies in this field are weak linear trends and small sub-oval and sub-circular positive anomalies. Some of the linear anomalies are aligned with the current field boundaries and clearly relate to ploughing whereas others are of uncertain origin and may prove to be archaeological. The small sub-oval and sub-circular positive anomalies are considered to represent anything from geological responses, ferrous spikes or small archaeological features. As they have no obvious anthropogenic patterning in their spatial distribution they are classed as possible archaeology.	4.2.34	The remaining anomalies are small sub-circular and sub-oval shaped positive anomalies. These features may represent archaeological features but as there is no significant patterning in their spatial distribution they have been classed as possible archaeology. There is a concentration of ferrous responses at 4025; these responses will obscure any archaeological features that may be present in this area.
			<i>Interpretation: modern services</i>
4.2.25	The smallest central field is covered in ferrous responses that render the identification of potential archaeological features in the data very difficult. There is only one noteworthy anomaly which is a very weak broad sub-oval shaped spread at 4006; this feature has magnetic values less than +2nT and is barely visible among the ferrous. This feature may either represent a cut archaeological feature or a geological feature; the anomaly has been classed as possible archaeology due to the uncertainty in the interpretation.	4.2.35	There are several modern services visible in the data. Pylon bases are present at 4007, 4019, 4020, 4021 and 4024; the pylon at 4021 links up with the possible cable response at 4005, 4008 and 4024. This suggests this service maybe an underground electricity cable. A bipolar response is present at 4022 and 4023, this is thought to possibly represent a pipe.
4.2.26	A base of a wooden pylon is visible in the data at 4007 and the possible cable observed in the previous field is visible at 4008. These services will be discussed in more detail in the next section of the report.	4.2.36	It is not clear from the geophysical data whether the services identified are in active use or not. Also gradiometer data will not be able to locate and identify all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.
4.2.27	There are a few trends and small positive responses visible in the data; some are clearly agricultural but others may prove to be archaeological.		Conclusions
			<i>Introduction</i>
		4.2.37	The detailed gradiometer survey has been successful in detecting anomalies of likely and possible archaeological interest within the Site, in addition to regions of increased magnetic response, the presence of ceramic field drains across two areas of the Site and numerous trends of uncertain origin.

Discussion

- 4.2.38

The data shows several anomalies of likely archaeological interest and some of these may relate to the cropmarks identified from aerial photographs. The wide spreads of ferrous anomalies is likely to have obscured some important detail in the vicinity of these potential archaeological features.
- 4.2.39

This field has clearly been covered with a lot of strongly magnetised debris. This debris has magnetic values that are high enough to mask the weaker responses expected from archaeological features. This has reduced the area in which archaeological features are visible, especially around services and field edges. It may be that more archaeological features are present than were detected in the geophysical data presented in this report.
- 4.2.40

The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; it is assumed that the centreline of services is coincident with the centreline of their anomalies. It is difficult to estimate the depth of burial of the services through gradiometer survey.
- 4.2.41

It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey. Given how weak many of the features interpreted in this data are it seems very likely that more features may be present than were detected during the survey.
- 4.2.42

One possible explanation for the weak magnetic values seen for lots of anomalies in the survey area, such as at 4001, is that a large number of ploughing trends have been identified right across the Site possibly causing plough damage to the features and resulting in the weakly contrasted anomalies seen here. Indeed plough damage has been described on several of the HER records from this area where successive aerial photographs have been compared over the same site (PastScape ID 1528220). This could be evident in the area of 4009 where multiple linear trends interpreted as ploughing trends have resulted in an area where little or even no anomalies of archaeological potential have been identified perhaps due to their being ploughed out. This is relevant right across the site where many anomalies have been identified as possible archaeology (weak response).

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Ordnance Survey (1977), Quaternary Map of the United Kingdom: South. Ordnance Survey: Southampton.

Ordnance Survey (1957), Sheet 2, Geological Map of Great Britain: England and Wales. Ordnance Survey: Chessington.

Wessex Archaeology (2013), HS2: *Geophysical Survey Written Scheme of Investigation*. Report Reference: 86254.01.

HER records consulted

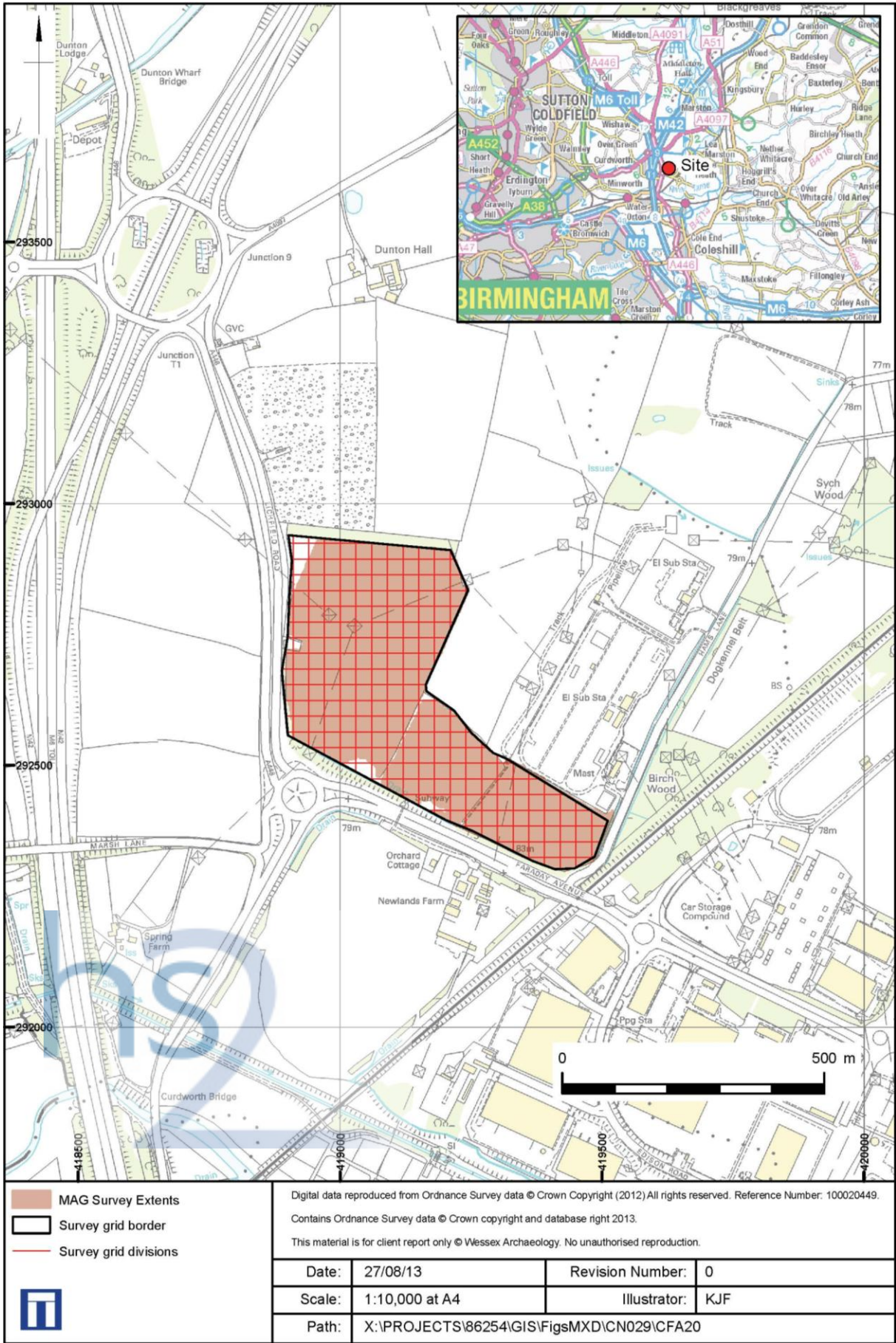
- MWA41 – Church of St. Peter and St. Nicholas, Curdworth
- MWA42 – Site of possible medieval cross at Curdworth
- MWA43 – Moat at Curdworth Hall Farm
- MWA44 – Dunton Hall, Curdworth
- MWA45 – Dunton Hall Dovecote, Curdworth
- MWA47 – Findspot, Bronze Age axehead in the parish of Curdworth
- MWA51 – Curdworth Bridge, remains of
- MWA52 – Curdworth Bridge
- MWA4882 – Findspot, Roman pottery sherd
- MWA6227 – Site of manor house at Curdworth Hall Farm
- MWA6610 – Site of windpump S of Dunton Hall
- MWA9098 – Linear features, east of Curdworth Hall Farm, Curdworth, Warwickshire
- MWA9099 – Pit, east of Curdworth Hall Farm, Curdworth, Warwickshire
- MWA9509 – Curdworth Medieval Settlement
- MWA12038 – Charcoal manufacturing sites in Curdworth Parish
- MWA12046 – Ring ditch and linear features in Curdworth Parish
- MWA12047 – Ridge and furrow in Curdworth Parish
- MWA12547 – Hams Hall park/garden, Lea Marston

English Heritage PastScape records

- Monument No. 332058 – Findspot, Early Bronze Age finished axe (EH332058)
- Monument No. 332068 – Findspot, Middle Bronze Age palstave (EH332068)

Figures

Figure 15: Site location



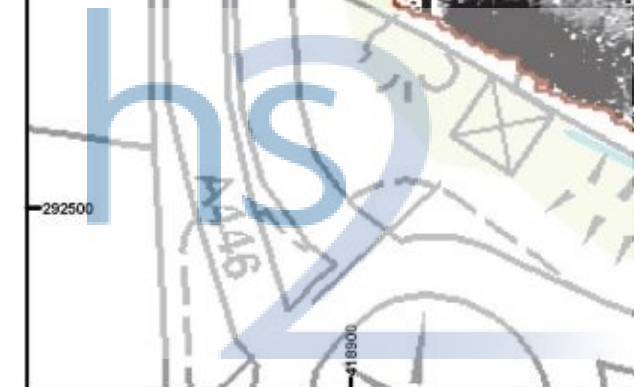


Figure 17: XY trace: north-west

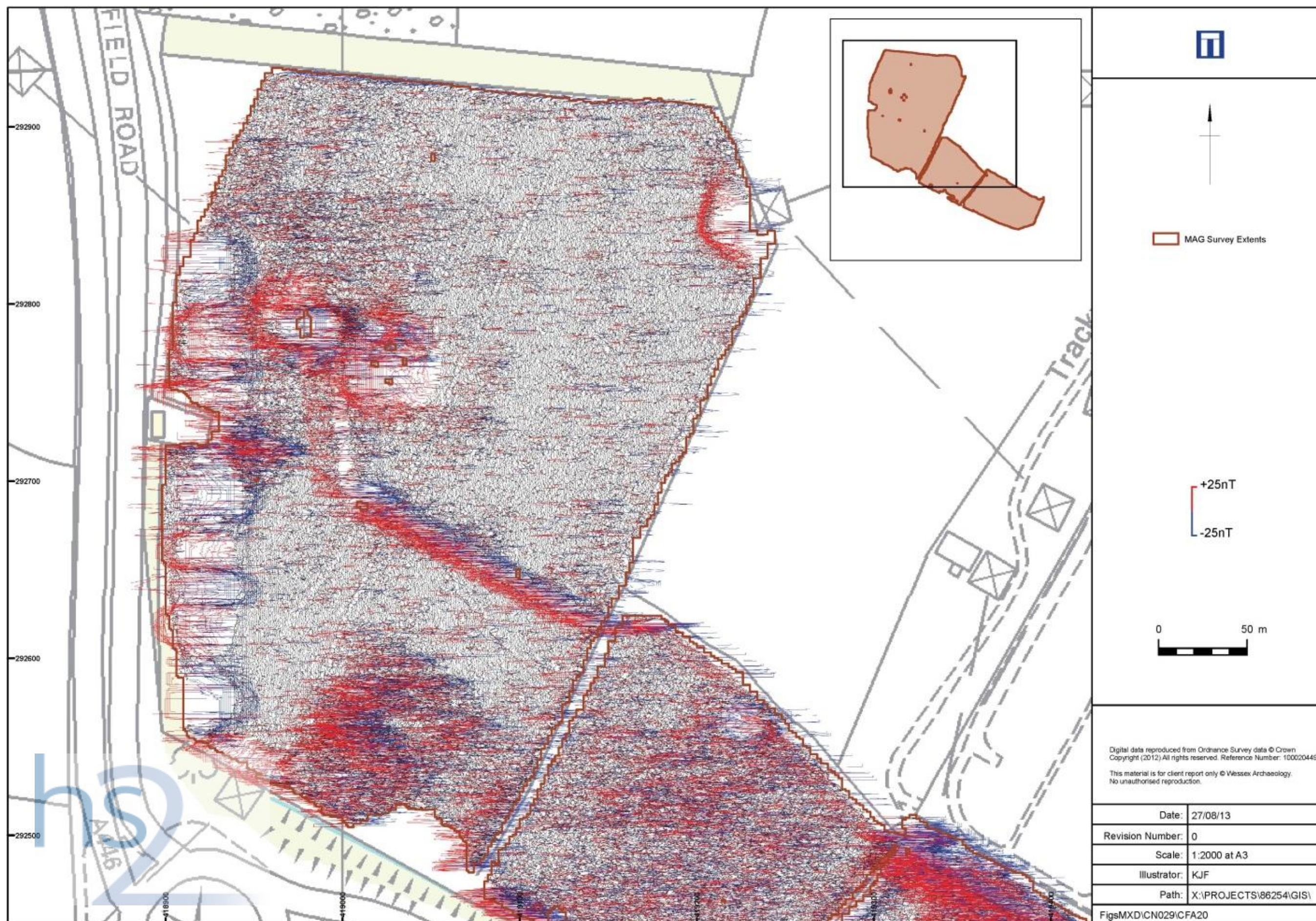


Figure 18: Interpretation: north-west

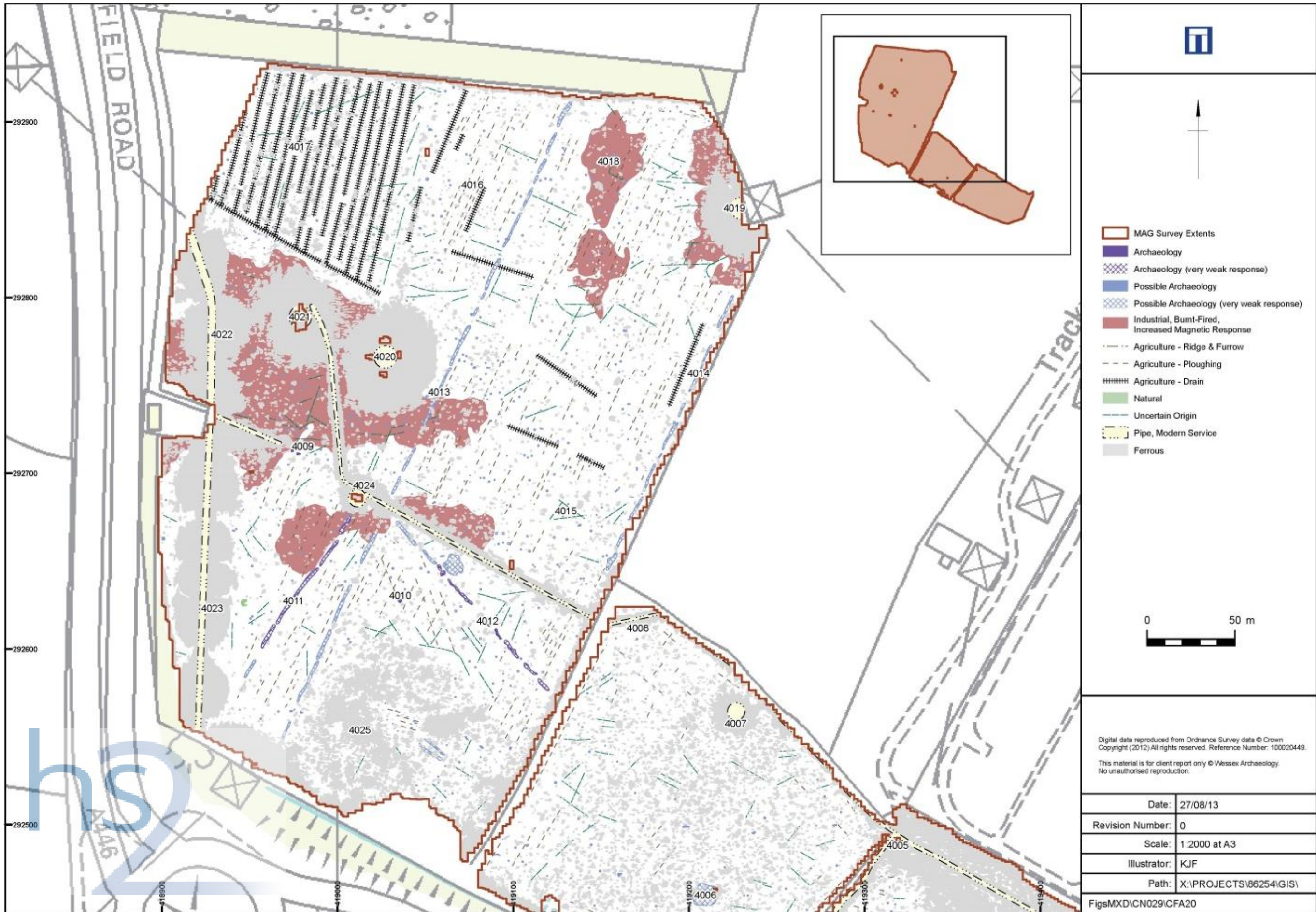


Figure 19: Greyscale plot: south-east



Figure 20: XY trace: south-east

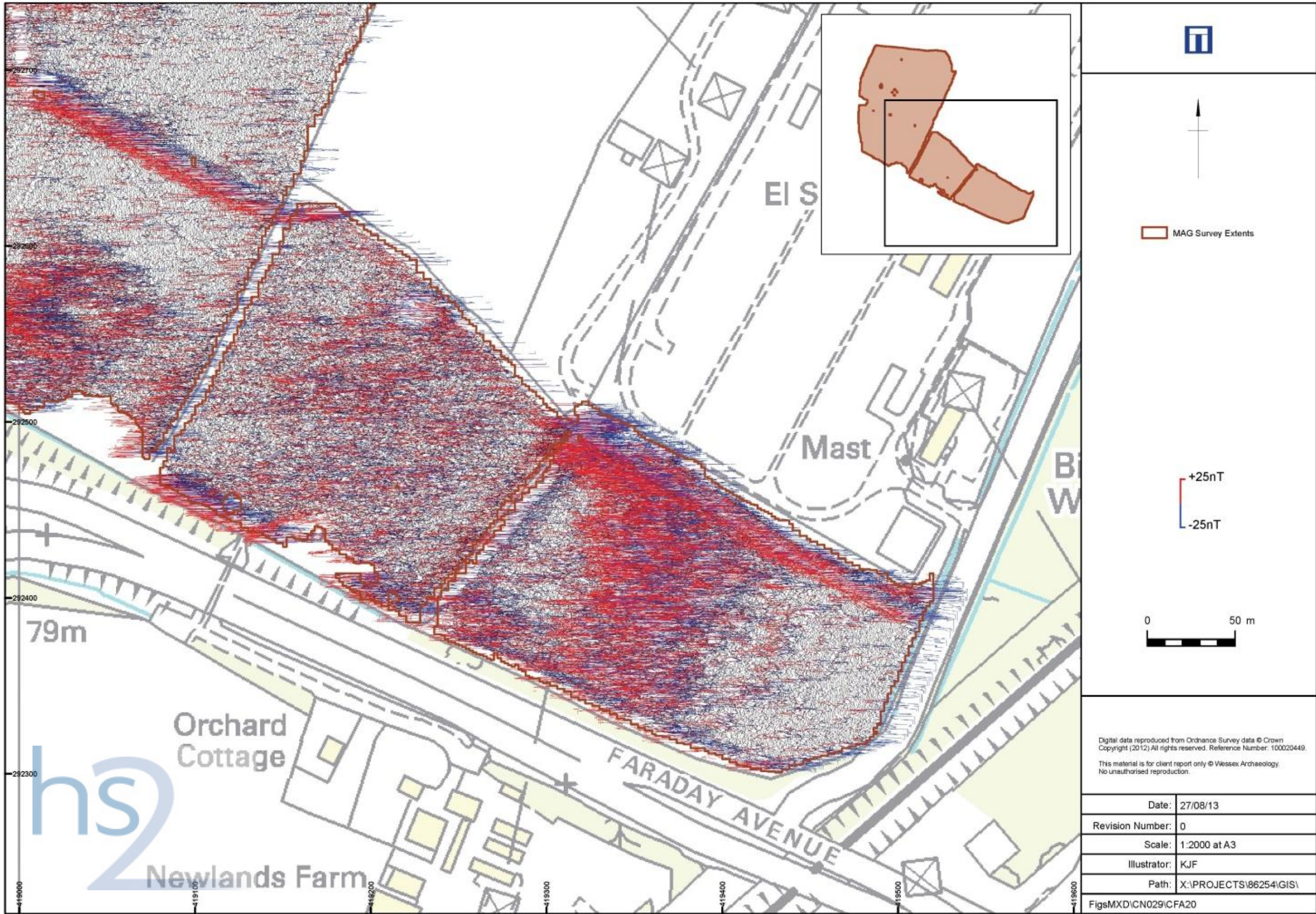
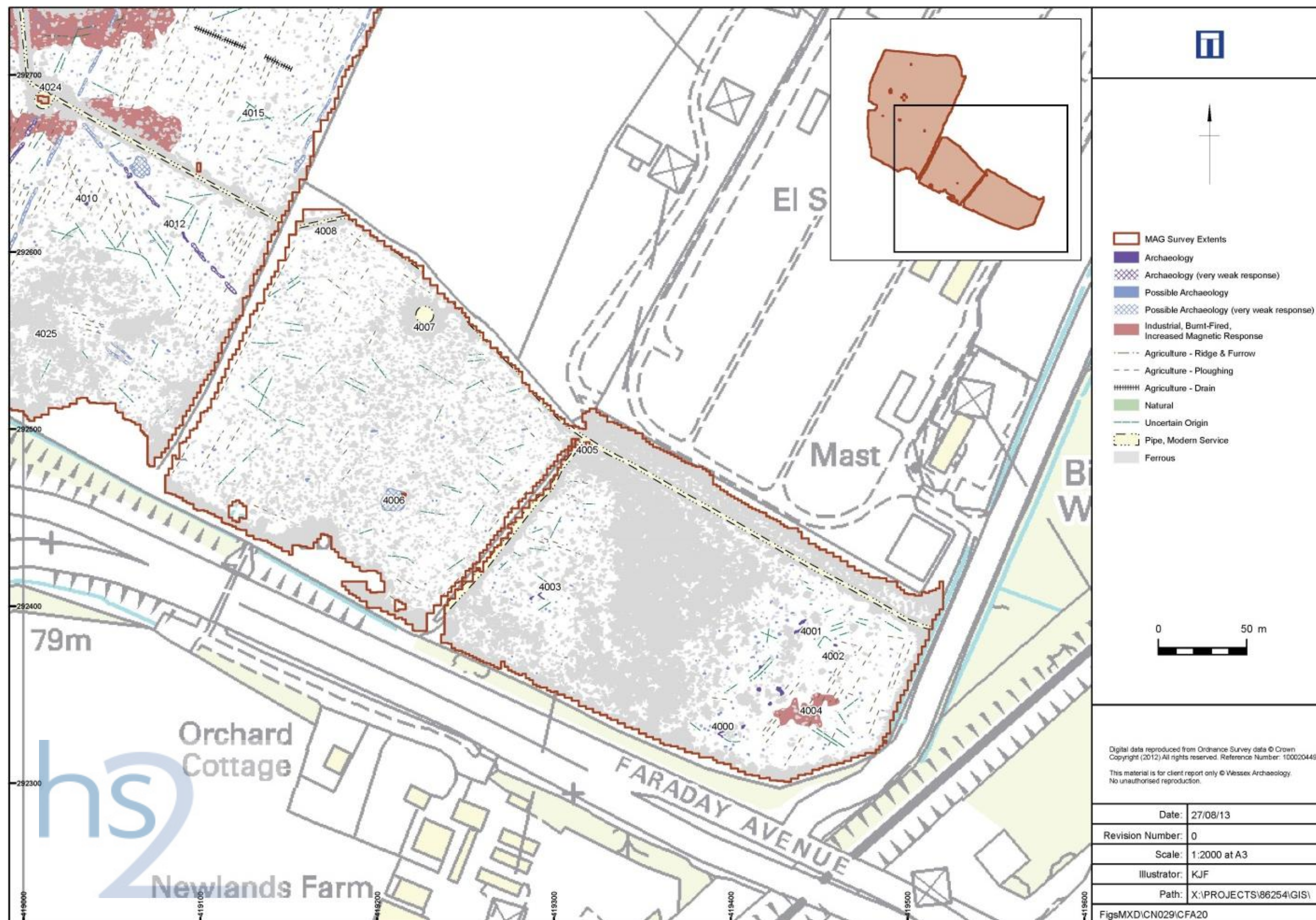


Figure 21: Interpretation: south-east



4.3 Appendix 1. Survey equipment and data processing

Survey methods and equipment

- 4.3.1 The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.
- 4.3.2 The gradiometers have an effective resolution of 0.03nT over a ± 100 nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.
- 4.3.3 Wessex Archaeology conducts detailed gradiometer surveys using an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.
- 4.3.4 The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH 2008).
- 4.3.5 Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-processing

- 4.3.6 The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.
- 4.3.7 As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.
- 4.3.8 Typical data and image processing steps may include:
- Destripe – applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
 - Destagger – shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;

- Despike – filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data);
- Deslope – this function is used to remove a linear trend within a data set. It is most commonly used to remove grid edge discontinuities that can result from applying zero mean traverse to a data set.
- Multiply – the multiply function multiplies the data by a negative or positive constant value. It has a variety of functions but its typical use is to normalise data that has been collected with sensors at different heights from the ground.

4.3.9 Typical displays of the data used during processing and analysis:

- XY plot – presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

4.4 Appendix 2: Geophysical interpretation

Interpretation categories

- 4.4.1 The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.
- 4.4.2 The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:
- 4.4.3 Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- 4.4.4 Possible archaeology – used for features which give a response but which form no discernible pattern or trend.
- 4.4.5 The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:
- Industrial, burnt-fired, increased magnetic response – used for areas dominated by bipolar and dipolar anomalies which may have some archaeological potential.
 - Uncertain origin – used for low amplitude or indistinct linear anomalies.
 - Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
 - Agricultural – used for linear trends that can be shown to relate to agricultural activity including ridge and furrow, drainage and ploughing scars.

- Natural – used for spreads of anomalies that are considered to be geological or more discrete anomalies considered to be natural.

4.4.6 Finally, services such as water pipes are marked where they have been identified along with ceramic field drains.